FINAL REPORT ON THE MONITORING AND OPTIMIZATION OF THE ANAEROBIC DIGESTION OF WHEY AT MILLBANK CHEESE AND BUTTER LTD.

Renewable Energy Branch

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PREFACE

This report is intended to describe the optimization and monitoring project that was conducted at the full-scale anaerobic digestion facility at Millbank Cheese and Butter Ltd. in Millbank, Ontario from September 1985 to August 1986.

The overall purpose of the project was to optimize the operation of the full-scale facility through achievement of the design loadings, thereby generating the best economic return for the facility. Two factors that greatly affect this return are the current energy costs (fuel and hydro) and the current whey disposal costs.

The work conducted as part of this project is very significant to research on the anaerobic digestion of whey as it provides information obtained at full-scale. Most of the other published work on the anaerobic digestion of whey to date describes work either at bench-scale or lab-scale. This report, as well as being important to research and researchers, will also be valuable to cheese plant managers who are looking at alternative whey disposal methods.

ABSTRACT

The objective of this project was to optimize the operation of the full-scale anaerobic digestion and energy recovery facility located at Millbank, Ontario. This facility was designed to treat whey and generate a methane rich fuel for utilization in a cheese plant boiler. From the time the construction was completed in July 1984 to the summer of 1985, it was never possible to achieve stable digester operation, or to attain the design loading of 2.95 kg COD/m^3 digester volume/day or to achieve the design hydaulic retention time (HRT) of 22 days.

Seven lab-scale reactors were set up on-site as part of this project in a mobile environmental trailer. These reactors were fed whey and various nutrient/buffer supplements in an attempt to develop operating parameters that would allow the full-scale digester to achieve stable operation. These 7 reactors, as well as the full-scale facility, were monitored daily so that any problems with their operation could be identified early.

The findings of this project indicate that with daily additions of a nutrient/buffer supplement such as 10% digested swine manure the design loading of 2.95 kg COD/m^3 digester volume/day could be achieved. The findings of this project also confirmed that it is unlikely that whey can be digested without the addition of some nutrient/buffer supplement.

This project is significant in that it will provide any potential users of anaerobic digestion facilities with some detailed full-scale data. This report also provides information associated with problems that may arise during the start-up of a full-scale facility.

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EXECUTIVE SUMMARY

A full-scale anaerobic digestion and energy recovery facility was constructed at the Millbank Cheese and Butter Ltd. cheese plant in Millbank, Ontario during the fall of 1983 and the spring and summer of 1984. This facility had a COD design loading of 2.95 kg COD/m^3 digester volume/day and a design HRT of 22 days.

In August of 1984, this facility was started up using digested manure as a seeding substrate. From September 1984 - February 1985, a monitoring program was conducted to obtain information on start-up and steady state operation. During this period, raw whey was batch fed daily into the full-scale digester. The results of this monitoring program and an internal research study by CANVIRO Consultants showed that the full-scale digester was unable to achieve steady state operation on raw whey and that some nutrient/buffer supplement addition to the raw whey was required if steady state operation was ever to be obtained.

The primary objective of this project was to optimize the operation of the full-scale anaerobic digestion and energy recovery facility. To accomplish this, Several nutrient/buffer supplement additions were evaluated at lab-scale in an attempt to devise a solution for the full-scale facility. The project itself was divided into 6 tasks as follows:

Task 1: State-of-the-Art Review
Task 2: Mobilization and Set Up of Mobile Enviromental Trailer On-Site
Task 3: Operation and Monitoring of Lab-Scale Reactors
Task 4: Optimization and Monitoring of the Full-Scale System
Task 5: Technical and Economic Assessment
Task 6: Information Transfer

The state-of-the-art review which was conducted as part of this project was comprised primarily of a literature review. Two computer searches were conducted to obtain the most up-to-date information on the anaerobic digestion of whey. The results of the literature review showed that much

of the recent work conducted at lab-scale on whey had required a nutrient/buffer supplement addition to obtain stable operation. However, many of these supplements would not have been economical to implement at full-scale. One other finding of the literature review was that much of the previous research had been conducted on diluted whey powder as opposed to raw whey. The COD of this diluted whey powder is in the 10,000 mg/L range while the COD of whey is generally in the 65,000-70,000 mg/L range. This tends to make comparisons difficult and the problem of scale-up very tedious.

This project began in September of 1985 and the mobile environmental trailer was on-site and completely hooked up and ready for operation by September 18, 1985 (Task 1 complete). This trailer was to serve 2 purposes during the project:

1) to house the lab-scale reactors required for this study, and
2) to allow for on-site monitoring (pH, temperautre, volatile acids, alkalinities) of the full-scale digester and the lab-scale reactors.

The lab-scale work began on September 18, 1985. At this time, 7 reactors were set up in the mobile analytical trailer. Six of these were 25 litre volume complete mix reactors while the seventh was a 50 litre fixed film reactor.

The nutrient/buffer supplements used in this study included municipal digester supernatant from a municipal wastewater treatment plant, digested swine manure from a hog farm and caustic (NaOH). These supplements were selected for this study as they were readily available and could be obtained at a cost which was believed would be economical if their addition to raw whey was successful.

In addition, the project examined the effect of operating at thermophilic (55°C) temperature versus mesophilic (35°C) temperature, the effect of daily additions of supplement versus weekly additions of supplement and the difference between complete mix operation and fixed film operation.

The findings of the project with respect to the lab-scale work are summarized below:

1. Loadings up to approximately 75% of design loadings can be obtained with daily additions of 15% municipal digester supernatant.
2. Loadings greater than the design loadings can be obtained with daily additions of 10% digested swine manure.
3. The use of caustic (NaOH) indicated that prolonged use caused sodium toxicity within the reactor.
4. The loadings obtained with a fixed film operation and those obtained at thermophilic (55°C) temperature with daily additions of 10% digested swine manure were approximately equal to those obtained with the mesophilic complete mix operation with daily additions of 10% digested swine manure.
5. The start-up of the lab-scale reactor seeded with August 1984 full-scale digester effluent and supplemented with 15% municipal digester supernatant was much faster than that achieved with the 10% daily addition of digested swine manure supplement. However, when an attempt was made in later work to start-up a reactor from 'scratch' with raw whey and the municipal digester supernatant, the start-up process proved to be very slow.
6. Work with daily supplement additions versus weekly supplement additions showed daily supplement additions allowed for greater loadings (in the order of 10-20%). It was never explored but it was believed that daily loadings would have an even more positive effect at start-up.

The full-scale optimization and monitoring work (Task 4) extended from September 1985 through August 1986. Initially, from September 1985 to December 1985, the full-scale digester was supplemented with digested swine manure every other week. This proved unsatisfactory as it was not possible to increase the whey loadings. In January 1986, supplementation of the full-scale digester with 15% municipal digester supernatant began. This continued until the end of the project. Initially, the digester was slow to respond and it was not possible to increase the loadings. However, towards the end

of May 1986, the full-scale digester achieved stable operation and, as a result, the digester loadings were increased. By July 1986, the digester was capable of daily COD loadings greater than 1.4 kg COD/m^3 digester volume/day. These were not increased further as it was not possible to utilize any more biogas than this loading generated in the cheese plant in the summer. However, it is believed that this loading could be increased during the winter months when fuel for heating the cheese plant is required.

The technical and economic assessment (Task 5) indicated that with optimized operation, the anaerobic digestion and energy recovery facility has an estimated net annual energy recovery of 5,252 GJ and generates an estimated net annual profit of just over $5,000.00.

1.0 INTRODUCTION

1.1 Background

In 1982, Millbank Cheese and Butter Ltd. had whey hauling costs of greater than $60,000.00. By 1983, this cost had doubled and indications were that it might double again before the end of 1983. This would have resulted in annual whey disposal costs approaching $250,000.00.

In 1983, Millbank Cheese and Butter Ltd. engaged CANVIRO Consultants Ltd. to evaluate other whey disposal alternatives. The results of this work (CANVIRO, 1983) indicated that an anaerobic digester to treat the whey and generate a methane rich fuel had the greatest potential. Because this alternative fell within the guidelines of the Canada-Ontario Bilateral Agreement on the Development and Demonstration of Renewable Energy and Energy Conservation Technologies, application was made to the Ontario Ministry of Industry and Trade (MIT) for funding assistance to develop this alternative. In July 1983, an agreement between Millbank Cheese and MIT was reached.

The construction of the anaerobic digester facility was completed in July 1984 and Figure 1 provides a detailed schematic of this. Upon completion of the construction, a 6 month monitoring program began. During this monitoring, the design loadings of 2.95 kg COD per cubic meter of digester and the hydraulic retention time (HRT) of 22 days were never achieved (CANVIRO, 1985a) due to problems associated with high volatile acid concentrations and low pH. Due to the relative shortness of this program, it was not possible to determine with certainty the exact reasons for this. However, based on the results of the program, the following was observed and concluded:

1. The full-scale digester was not likely to ever achieve the design loadings and steady state operation without the addition of some buffer/nutrient supplement.
2. A pH greater than 6.8 and a Volatile Acid: Bicarbonate Alkalinity ratio less than 1.0 were required for steady state operation of the full-scale digester.

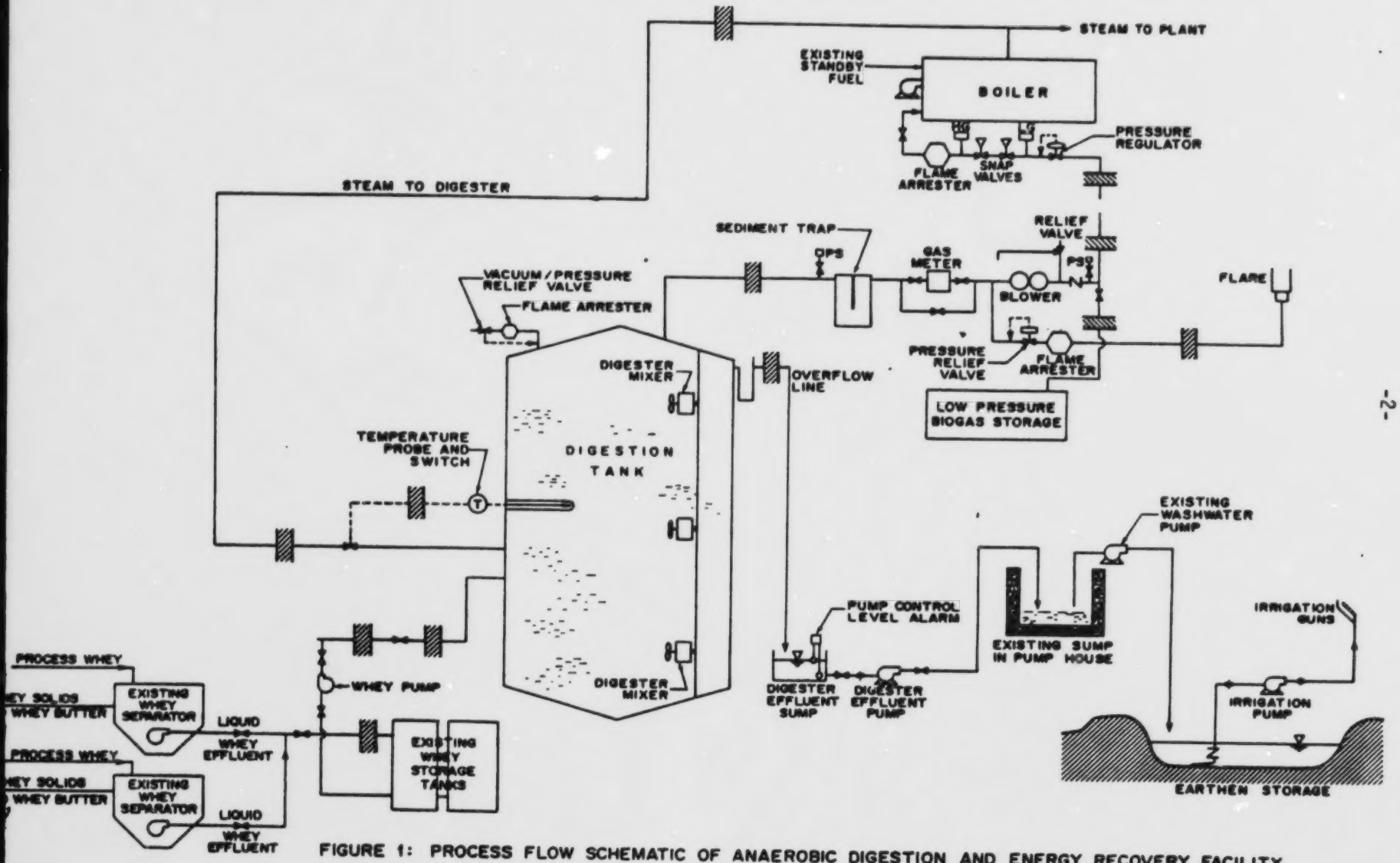


FIGURE 1: PROCESS FLOW SCHEMATIC OF ANAEROBIC DIGESTION AND ENERGY RECOVERY FACILITY

3. For any future studies, the whey from the Millbank cheese plant could be characterized as follows:

Total COD	67,300 mg/L
Total BOD	37,260 mg/L
Total Solids	59,900 mg/L
Total Susp. Solids	1,100 mg/L
TKN	1,320 mg/L
Ammonia	260 mg/L
Total P	460 mg/L

Based on the above, CANVIRO began an internal research project CANVIRO 1985b) in their laboratory in Kitchener, Ontario in March 1985. For this project, 6-25 litre completely mixed reactors were set up and fed whey daily. Along with the whey fed, various supplements were added to each of the reactors in an attempt to reduce the volatile acids concentration and consequently reduce the hydraulic retention time. Some of the supplements added to the lab-scale reactors included:

1) Caustic (NaOH)
2) Digested hog manure from a full-scale digester
3) Liquid fertilizer (nitrogen)

Initially, during this internal research project, the addition of caustic was believed to be achieving the best results. However, as time progressed, the reactors receiving caustic experienced poor COD reductions and elevated volatile acid concentrations. This was believed to be caused by sodium toxicity.

The reactor receiving the digested hog manure was very slow to respond. However, by July 1984, it had achieved stable operation and a HRT of 35 days.

Because the initial work with caustic at lab-scale indicated some success, the pH and VA/BA ratio of the full-scale digester at the Millbank cheese plant were controlled with caustic during the Spring of 1985. However, by June 1985, the full-scale digester's performance had become unsatisfactory as had happened at lab-scale.

By this time, it was apparent that more study was required to determine the optimum conditions for operation of the full-scale anaerobic digestion facility. Therefore, in July 1985, National Consolidated Food Brands Inc. (NATCO) which had purchased Millbank Cheese and Butter Ltd. in the Fall of 1984, submitted a proposal prepared by CANVIRO Consultants Ltd. to Energy, Mines and Resources Canada (EMR) requesting funding assistance to monitor and optimize the facility. This proposal was subsequently accepted and an agreement between Natco and EMR was reached in August 1985. This report provides the results of the monitoring and optimization work that was carried out during that project.

1.2 Project Objectives

The primary objective of this study was to achieve the optimum operating conditions for the full-scale anaerobic digester located at the Millbank cheese plant.

The specific objectives of this study initially included the following:

1. Setting up of a mobile environmental trailer on-site to enable immediate analysis.
2. Operation of 6 lab-scale reactors on-site to assess and optimize key operating parameters such as pH, loading rates, gas production and temperature.
3. Operation and monitoring of the full-scale digester under "optimum conditions" as these evolve.
4. Preparation of a technical and economic assessment of the optimized system.
5. Preparation of a final report and additional technology transfer information for presentation at a major technical conference.

2.0 PROJECT TASKS

2.1 General

The project was divided into 6 major tasks to meet the objectives of Section 1.2. These 6 tasks are listed below and discussed in subsequent sections:

Task 1: State-of-the-Art Review
Task 2: Mobilization and Set Up of Mobile Environmental Trailer On-Site
Task 3: Operation and Monitoring of Lab-Scale Reactors
Task 4: Optimization and Monitoring of the Full-Scale System
Task 5: Technical and Economic Assessment
Task 6: Information Transfer

2.2 Task 1: State-of-the-Art Review

2.2.1 Method

The state of the art review was comprised primarily of a literature review. This included two computer searches for literature references. These were conducted during the project to obtain the most up-to-date information on the anaerobic digestion of whey. The first was conducted at the University of Guelph and the second was conducted at the University of Waterloo. A copy of the computer search conducted at the University of Waterloo has been included as Appendix A. The information obtained from the literature references in the computer searches with respect to the anaerobic digestion of whey is discussed below.

2.2.2 Results and Discussion

The anaerobic treatment of whey has been described as a two stage process (Zeikus et al, 1985). The first stage involves the conversion of lactose, the major component of whey into volatile acids. This is accomplished by a group of microorganisms known as acetogens. The second stage involves the conversion of the volatile acids to methane. This is accomplished by another group of microorganisms known as methanogens. The reduction of carbon dioxide and hydrogen is also responsible for a small portion

of the total methane produced (Zeikus et al, 1985). Methanogens have longer growth rates, and are more sensitive to changes in environmental conditions than acetogens. Therefore, methanogenesis is considered to be the rate-limiting step in the digestion of soluble substrates, such as whey (Li et al, 1982).

The parameters which have been found to be of significance in the control and operation of anaerobic digestion are loading rate, feed concentration, nutrient addition, pH and temperature. The loading rate is usually measured in terms of kilograms of COD or BOD added to a cubic meter of digester per day. COD (chemical oxygen demand) and BOD (biological oxygen demand) are measures of the organic material in a liquid that is potentially available for digestion.

A number of researchers have found that as the loading rate is increased, the COD removal rate increases, while the overall COD removal efficiency decreases [Yang et al (1982), Boening & Larsen (1982), Li et al (1982)]. Yang et al (1982) attributed the increased COD removal rates to a build up of higher cell densities in the reactor. They found that cell density in the reactor was proportional to the organic loading rate, if the removal efficiency is fairly constant. Zeikus et al (1985) reported that increasing the loading rate caused an accumulation of metabolites. The first were acetate and propionate, followed by hydrogen, butyrate, and lactate and finally lactose. It is the accumulation of acetate which is believed to be responsible for decreased removal efficiencies. Omstead et al (1980) suggested that as the acetate concentration reaches some critical value, a shift in the fermentation pattern occurs. This causes a decrease in acetate production, while the production of higher molecular weight acids increases. A cessation in methane production generally accompanies this shift. Yang et al (1982) also noted that methane production decreased when the organic loading rate was increased. The lower methane production at higher loading rates may be partly due to a higher fraction of substrate being used for bacterial growth when plenty of substrate is available. Clanton et al (1981) found that changes in the loading rate did not affect the effluent TKN and ammonia levels.

A significant finding in the literature was that some previous research [e.g. Switzenbaum (1982), De Haast et al (1986)] associated with the anaerobic digestion of whey was conducted on diluted whey powder with a COD

of in the 10,000 mg/L range as opposed to full strength raw whey with a COD of 65,000 mg/L. This made comparisons difficult as the relationships between COD loading and hydraulic retention time (HRTs) were quite different for undiluted raw whey.

Another finding in many recent studies on the anaerobic digestion of whey, both on raw whey and on diluted whey powder was that some nutrient/buffer supplement addition was required. For example, Kelly and Switzenbaum (1984) investigated the effects of nutrient addition on the anaerobic digestion of whey. To the nutrient supplied whey they added: $(NH_4)2HPO_4$, MgC_2 - $6H_2O$, NH_4Cl, CoCl - $6H_2O$, $FeCl_3$ - $6H_2O$ and nickel standard. To the nutrient limited digester they added only $(NH_4)2HPO_4$. They observed that the soluble COD removal efficiency for the nutrient supplied digester was more than 1.3 times the soluble COD removal efficiency for the nutrient limited digester. The nutrient limited study indicated that the methanogens were more inhibited by the limitation than the acetogens. Chemical analysis of the whey indicated that potassium and magnesium were in sufficient quantity not to be limiting. Improved reactor performance was induced by the addition of either iron, cobalt, or nickel or some combination of those elements. De Haast et al (1986) indicated that an anaerobic system treating whey could not function with a buffer capacity of its own.

The recommended pH for the stable and efficient digestion of whey, depending on the author, is in the range of 6.7-8.2. In general, it was found that a low digester pH will cause a decrease in the biogas production and subsequent digester failure. Short exposure to a low pH results in short recovery times, while longer exposure to low pH resulted in longer recovery times. Low pH not only inhibits methanogenesis, but also changes the population distribution and fermentation pathways in the system [De Haast (1983)]. Below a pH of 6.6, significant hydrogen formation has been detected [Yang et al (1982)]. Methane inhibition may be caused by the accumulation of the anions associated with organic acids [De Haast (1983)].

Anaerobic digestion of whey is most efficient at a steady temperature in the range of 34-38°C [Reesen and Strube (1978)]. Kelly and Switzenbaum (1984) observed that the temperature had relatively little effect on reactor performance as defined by COD removal. The highest COD removal rates

were attained at 35°C. Removal efficiency decreased with lower temperature [Boening and Larsen (1982)]. The volatile acids increased with decreasing reactor temperature, suggesting that the methanogens are more affected by temperature than the acetogens.

It is evident from the research done, that the methanogens as a group, are much more sensitive to changes in their environment than the acetogens. They are therefore of greater concern when trying to effectively control the anaerobic digestion process.

One method that has been attempted to better control the anaerobic digestion process is to retain and/or maintain the anaerobic microorganisms, especially the methanogens, within the digester in sufficient numbers that the negative affects caused by environmental changes are minimized. There are several methods by which researchers have indicated some success. Two of these are the fixed film process and the sludge bed process.

The fixed film process utilizes an inert media (plastic tubing, sand, wood chips, etc.) which acts as a support surface for the growth of microbial films and provides a large surface to mass ratio. The sludge bed process utilizes natural flocculation or induced flocculation to retain the microbial biomass in the digester. Both of these processes allow a significant increase in biomass levels over conventional stirred reactors.

Seely (1981) reported attaining a loading rate of 4.9 kg COD/m^3/day with a COD removal efficiency of 93% and a HRT of 15 days, using a continuous stirred reactor (SCTR). Callander (1983) achieved a loading rate of 12.3 kg COD/m^3/day with a COD removal efficiency of 99% and HRT of 5.6 days, using a flocculated/stirred reactor. Numerous researchers have reported achieving significantly higher loading rates using fixed film/fluidized bed digesters. Hickey and Owens (1982) were able to achieve a loading rate of 37.6 kg COD/m^3/day, with a COD removal efficiency of 72% and a HRT of 1.4 days. At a loading rate of 13.4 kg COD/m^3/day and a HRT of 4.9 days, the removal efficiency was 83.6%. Utilizing a two stage fluidized bed reactor system Li et al (1982) achieved a COD removal of 93.9% at a loading rate of 10.6 kg COD/m^3/day with a HRT of 1.8 days. The whey was diluted to 9500 mg/L COD prior to digestion. Higher loading rates were not evaluated. These loading rates were substantially higher than the design loading rates for the Millbank cheese plant full-scale facility.

During this literature search, only one other full-scale whey digester was identified. This is the Hamworthy plant at South Caernarvon Creameries, near Pwllheli, North Wales. The anaerobic process employed there is a modified upflow anaerobic digester, in which the whey is fed up through a mass of very active flocculated bacteria together with the recirculated contents of the digester. A nutrient/buffer supplement (contents unknown) is being added to this digester. With this addition, the digester achieves COD reductions of 90% at a loading rate of 1.3-3.6 kg COD/m^3/day and a HRT of 18-40 days [Quickindom (1986)].

The results of the literature search indicate the following:

- Some nutrient/buffer addition is definitely required for the successful anaerobic digestion of whey.
- There has been a substantial amount of lab-scale research conducted and some very high loadings obtained, but, as yet, very little implementation at full-scale.
- The other identified full-scale facility is operating with nutrient/buffer supplement addition at loadings similar to the design loadings set for the full-scale system at the Millbank cheese plant.

2.3 Task 2: Mobilization and Set Up of Mobile Environmental Trailer On-Site

A mobile environmental trailer was delivered to the Millbank cheese plant site on September 6, 1985 and set up adjacent to the full-scale anaerobic digester facility as shown in Figure 2. All electrical, mechanical and other hook-ups required for the operation of this facility were completed by September 18, 1985.

The two major functions of this facility were to:

i) provide an area to set up the lab-scale reactors required for this project; and

ii) provide laboratory facilities for daily sampling, monitoring and analyses.

FIGURE 2: SET UP OF MOBILE ENVIRONMENTAL FACILITY ON-SITE

For this project, instead of the 6 lab-scale reactors originally proposed, 7 were set up. Six of these were stainless steel completely mixed anaerobic reactors having active volumes of 25 litres. The mixing in each of these was provided by top mounted, low rpm, mechanical mixers with three-4 blade turbine-type impellers installed along a shaft. To enhance the mixing, the reactors were fitted with baffles. Temperature control was achieved by immersion in an insulated, temperature controlled water bath.

The seventh reactor was a stainless steel fixed film reactor with an active reactor volume of 50 litres. This reactor was encased within a water jacket through which temperature controlled water was fed to ensure uniform temperature within the reactor. The reactor itself contained 4-1.2 meter sections of packing media, and was equipped with continuous recycle.

Whey to the 7 reactors was by a batch draw-and-fill method. The biogas production from these reactors was measured using Triton WRC low flowrate meters. Schematics showing these reactors are provided in Figures 3 and 4.

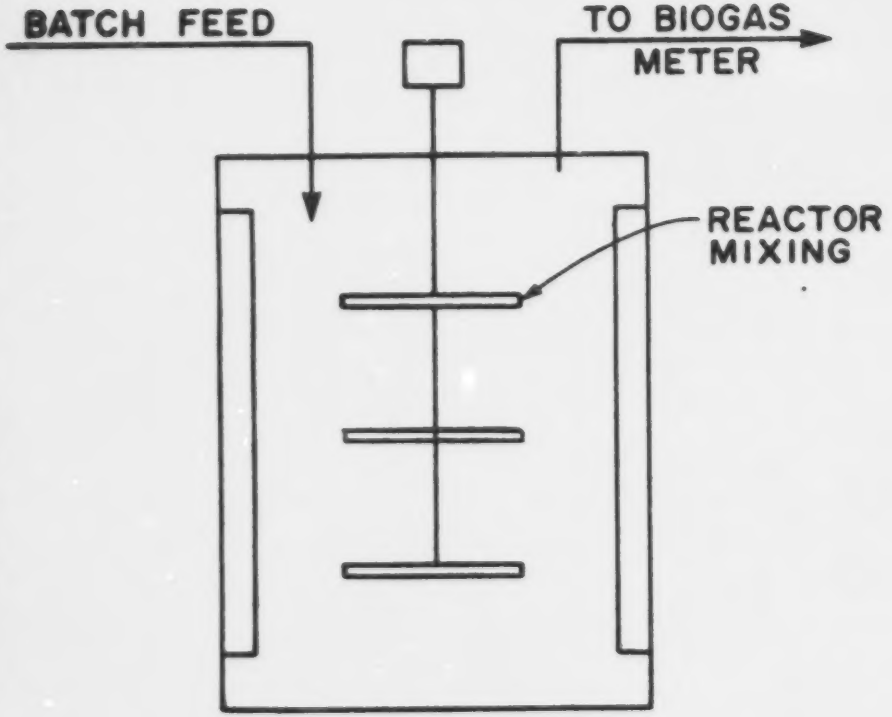


FIGURE 3: SCHEMATIC OF COMPLETE MIX REACTOR

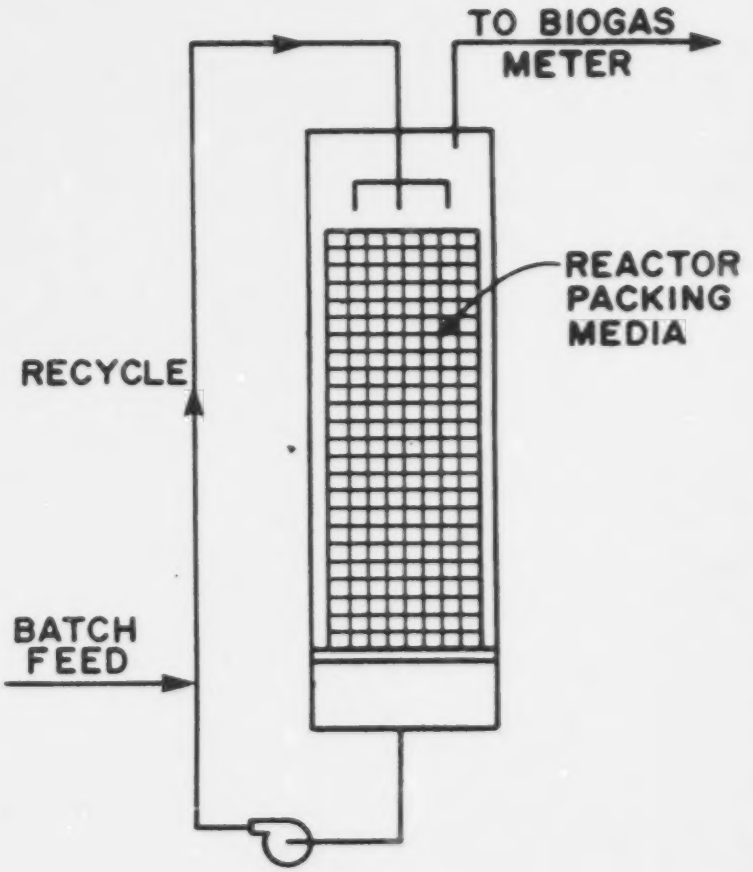


FIGURE 4: SCHEMATIC OF FIXED FILM REACTOR

In order to achieve some immediate feedback with respect to the operation of the lab-scale reactors and the full-scale digester, some monitoring was conducted on-site. This, as shown in Table 1, included daily measurements for temperature and pH, and twice weekly analyses of alkalinity, volatile acids, total solids, suspended solids and volatile solids.

TABLE 1. WEEKLY SCHEDULE OF ANALYSIS AT THE MOBILE ENVIRONMENTAL FACILITY

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
pH	x	x	x	x	x	x	x
Temperature	x	x	x	x	x	x	x
Alkalinity (Total Bicarbonate)	x				x		
Volatile Acids	x				x		
Total Solids			x				
Total Suspended Solids			x				
Volatile Suspended Solids			x				

x - Indicates day of analysis

In addition to the monitoring described above, samples were sent to CANVIRO's laboratory in Kitchener for further analysis. This, as shown in Table 2 below included analysis for COD, BOD, biogas quality, total Kheldahl nitrogen, ammonia and total phosphorus.

TABLE 2. WEEKLY SCHEDULE OF ANALYSIS AT CANVIRO'S LABORATORY

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
COD			x				
BOD*			x				
Biogas	x			x			
TKN*			x				
NH_3*			x				
TP*			x				

* Performed once every two weeks
x - indicates day of analysis

Prior to September 18, 1985, a decision was made to investigate the addition of municipal digester supernatant as a supplement to whey digestion. This supernatant was readily available at the City of Waterloo treatment plant and its supply was much more economical than digested swine manure or caustic. Therefore, a sixth mixed reactor was incorporated into the project to investigate the use of digester supernatant from a municipal wastewater treatment plant as a buffer/nutrient supplement. The 6 completely mixed reactors were designated as Reactors 1.0, 2.0, 3.0, 4.0, 5.0, and 6.0, and the fixed film reactor was designated as Reactor 7.0. The supplement additions to the 7 lab-scale reactors when the lab-scale portion of this study began on September 18, 1985 are briefly summarized below.

Digester #1.0: whey + 15% municipal sewage plant supernatant (35°C)

Digester #2.0: whey + 10% digested swine manure (35°C)

Digester #3.0: whey + 5% digested swine manure (35°C)

Digester #4.0: whey + 5% digested swine manure and addition of NaOH to maintain pH 7.0-7.3 (35°C)

Digester #5.0: whey + 10% digested swine manure and addition of NaOH to maintain pH 7.0-7.3 (35°C)

Digester #6.0: whey + 10% digested swine manure at thermophilic temperature range (55°C)

Digester #7.0: whey + 10% digested swine manure (35°C)

The operation of these lab-scale reactors is discussed in detail in Section 2.4.

The mobile environmental facility was operated by a graduate microbiology student from the University of Guelph from September 1985 to March 1986. During the mobilization and setting up of this facility, a daily routine was developed for this individual. Briefly, this routine was comprised of the following:

1. Feeding the lab-scale reactors during the morning 7 days a week.
2. Monitoring the pH and temperature of the 7 lab-scale reactors and the full-scale digester during the morning 7 days per week.
3. On-site sample analysis, report writing, data analysis and other duties during the afternoon 5 days per week.

The report writing mentioned above included the preparation of a weekly report which summarized operations at both full-scale and lab-scale. Copies of these weekly reports were forwarded to EMR Canada each month.

2.4 Task 3: Operation and Monitoring of Lab-Scale Reactors

2.4.1 General

On September 18, 1985, the operation and monitoring program for the lab-scale reactors began and by October 2, 1985, all 7 reactors were started up. The original intention was to continue the operation of these 7 reactors to the end of March 1986. However, as the study progressed, changes were continually made in some of the reactor's operation in an attempt to optimize the project. Some of these changes included:

1. Reactors 3.0, 4.0 and 5.0 attained their maximum loading rate prior to March 1986. Rather than continue their operation or shut these reactors down, these reactors were re-started and operated under 'new' conditions as Reactors 3.1, 4.1 and 5.1.
2. Due to encouraging results obtained from the operation of three reactors (Reactors 1.0, 2.0 and 4.1), laboratory-scale work continued on these through March 1986 until the end of June 1986.
3. The addition of the nutrient/buffer supplement to the lab-scale reactors was initially to be every 7-10 days. However, early indications were that if these were not added more often, the project might be over before any stable operation within the reactors had been achieved. Therefore, the supplement addition was changed to daily. Later in the study in April, May and June some work was done with weekly supplement additions.

The data obtained for each of the lab-scale reactors was logged into CANVIRO's computer to serve as a database for the study. A printout for each of the 7 lab-scale reactors has been included as Appendix B. The performance of the lab-scale reactors at maximum loadings (up to March 26, 1986) is summarized in Table 3 and discussed briefly below:

Digester #1.0 (15% digester supernatant addition): This digester acheived a loading rate of 2.2 kg COD/m^3/day volume, biogas quality of 59.8% CH_4 and BOD reductions of 94.0%.

TABLE 3. SUMMARY OF LAB-SCALE REACTOR PERFORMANCE AT MAXIMUM LOADINGS*

REACTOR	WHEY FED (mL/day)	COD LOADING RATE (kg COD/m^3 dig. vol.)	DIGESTER pH	HRT (days)	BIOGAS			TOTAL COD REDUCED (%)	TOTAL BOD REDUCED (%)	TOTAL SOLIDS CONCENTRAION REDUCED (%)
					PRODUCTION RATE (L/day)	CH_4%	CO_2%			
#1.0 + 15% municipal digester supernatant	800	2.2	6.9	27.2	23.4	59.8	34.4	81.2	94.0	77.6
#2.0 + 10% digested swine manure	1000	2.82	7.1	22.5	4.1	59.5	33.5	76.6	89.2	74.1
#3.0 + 5% digested swine manure	400	1.09	7.1	59.5	14.6	49.8	37.5	76.6	88.9	71.9
#3.1 + 15% municipal digester supernatant	400	1.08	6.75	54.4	13.9	48.6	35.4	NA	NA	NA
#4.0 + 5% digested swine manure and caustic addition	400	1.08	7.2	59.5	15.5	49.2	37.9	70.5	78.4	61.3
#4.1 + 15% supernatant	1000	2.7	6.88	21.7	34.1	56.9	31.3	NA	NA	NA
#5.0 + 10% digested swine manure	600	1.68	7.0	37.9	24.4	50.5	38.0	68.8	80.2	63.7
#5.1 full-scale duplication	300	0.82	7.1	68.3	17.7	56.3	35.6	88.6	95.8	85.2
#6.0 + 10% digested swine manure at 55°C	800	2.25	7.34	28.4	28.8	55.1	32.9	77.5	81.3	80.2
#7.0 + 10% digested swine manure (fixed film)	1800	2.54	6.78	25.3	66.3	57.1	32.5	74.9	84.5	73.8

* Covers time period from September 1985 to March 1986

Digester #2.0 (10% digested manure addition): This digester achieved a loading rate of 2.82 kg COD/m^3/day digester volume, biogas quality of 59.5% CH_4 and BOD reduction of 89.2%

Reactor #3.0 (5% digested manure addition): This reactor achieved a loading rate of 1.0 kg COD/m^3/day disgester volume, biogas quality of 49.8% Ch_4 and BOD reduction of 88.9%.

Reactor #3.1 (15% digester supernatant addition): This reactor achieved a loading rate of 1.08 kg COD/m^3/day and biogas quality of 48.6% CH_4.

Reactor #4.0 (5% digested manure addition with NaOH addition for pH control): This reactor indicated a loading rate of 1.08 kg COD/m^3 digester volume, biogas quality of 49.2% CH_4 and BOD reduction of 78.4%.

Reactor #4.1 (15% Supernatant addition): This reactor achieved a loading rate of 2.7 kg COD/m^3 digester volume at start-up. However, further study between April and June 1986 indicated that the maximum loading rate at steady state operation was 2.2 kg COD/m^3 volume which is essentially the same as found for Reactor 1.0.

Reactor #5.0 (10% digested manure addition with NaOH addition for pH control): This reactor achieved a loading rate of 1.68 kg COD/m^3 volume, biogas quality of 50.5 CH_4 and BOD reduction of 80.2%.

Reactor #5.1 (15% digester supernatant addition): This reactor operated at the same loading rates and nutrient/buffer additions as the full-scale digester. These loading rates were approximately 0.82 kg COD/m^3 volume. The biogas quality achieved was 56.3% CH_4 and the BOD reduction was 95.8%.

Reactor #6.0 (10% digested manure addition at 55°C): This reactor achieved loading rates of 2.25 kg COD/m^3 digester volume, biogas quality of 55.1% CH_4 and BOD reduction of 81.3%.

Reactor #7.0 (10% digested manure addition) - Fixed Film: The fixed film reactor achieved loading rates of 2.54 kg COD/m^3 digester volume, biogas quality of 57.1% CH_4 and BOD reduction of 84.5%.

Additional detail regarding the operation of each of the lab-scale reactors up to March 26, 1986 is provided in Section 2.4.2.

By March 26, 1986 when the lab-scale work had been scheduled to end, it was apparent that some additional work with the most successful reactors would be of value. Therefore, Reactors 1.0, 2.0 and 4.1 were kept operating until June 1986. The results of this additional laboratory-scale work are given in Section 2.4.3.

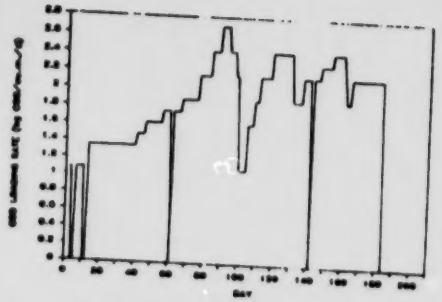
2.4.2 Lab-Scale Reactor Operation from September 1985 - March 1986

Reactor #1.0 - 15% Municipal Digester Supernatant Addition

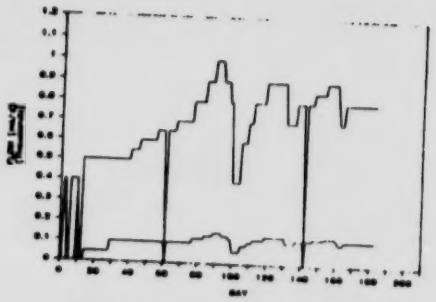
This reactor was started up on October 2, 1985 (Day 1) using 25 litres of effluent from the full-scale digester as seed. The addition of supernatant was initially 10% of the whey fed. This was increased to 20% on Day 29 (Oct. 30). The percentage of the supplement added was decreased in the subsequent weeks by increasing the amount of whey being fed while maintaining the feedrate of the supernatant. By Day 76 (Dec. 16), the percentage of supernatant added had decreased to 14%. Some instability was observed at this time and the rate of addition was increased to 15%. This addition rate was maintained through March 1986.

Results

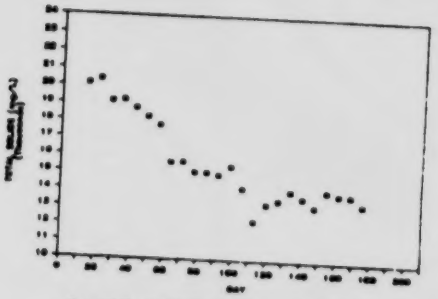
The data obtained from monitoring this reactor is provided in Appendix B in Table B-1 and summarized graphically in Figures 5(a) to 5(j). Figure 5(b) shows the volume of whey and supernatant added daily. At start-up the feedrate was 400 mL/day. Figures 5(d) and 5(e) show that the VA/BA ratio increased and the pH decreased immediately. The feedrate was increased to 500 mL/day on Day 13 (Oct. 14) and maintained at this level until Day 41 (Nov. 11). During this time the VA/BA ratio increased to 1.8 on Day 31 (Oct. 31), with a steady decline following. The pH stabilized in the range of 6.8-7.0. Figures 5(c) and 5(f) show that during this period the total COD and total solids concentration (TS) remained high, while Figures 5(h) and 5(j) show that total suspended solids (TSS), volatile suspended solids (VSS), and biogas production remained low.



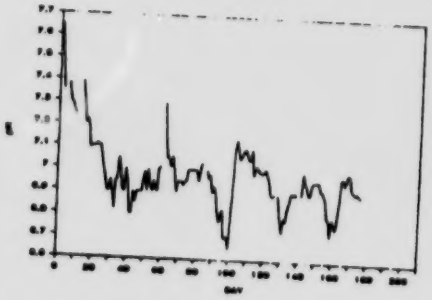
a) COD LOADING RATE



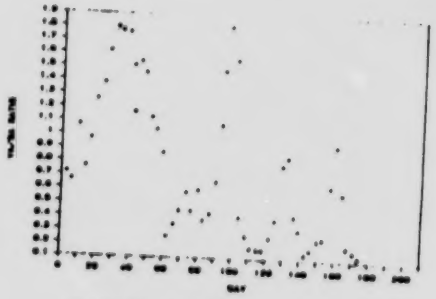
b) DAILY FLOW



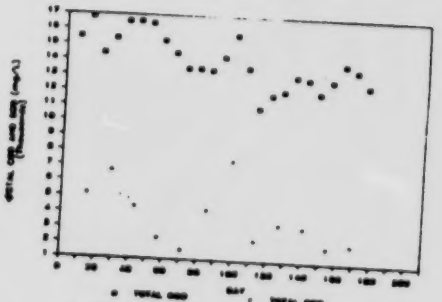
c) EFFLUENT TOTAL SOLIDS



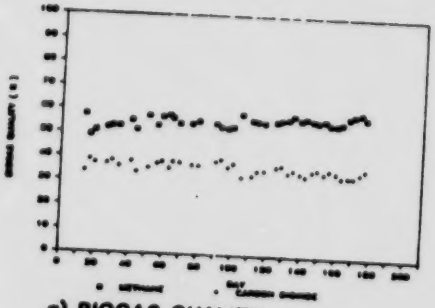
d) DAILY pH



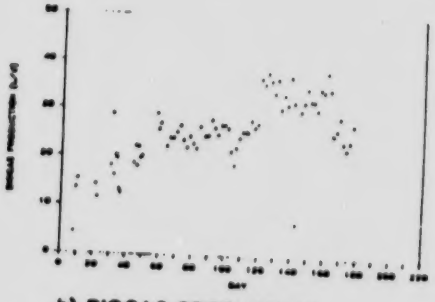
e) VA/BA RATIO



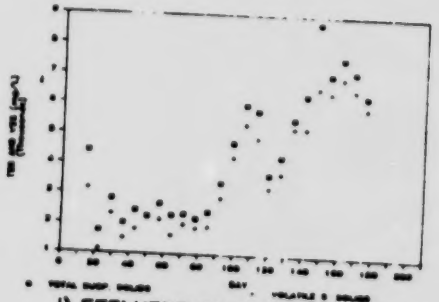
f) EFFLUENT COD & BOD



g) BIOGAS QUALITY



h) BIOGAS PRODUCTION



j) EFFLUENT SUSPENDED SOLIDS

FIGURE 5: DATA SUMMARY FOR REACTOR 1.0

During the next 40 days (Days 40-80) the VA/BA ratio decreased, the pH stabilized and the COD and TS decreased, while the biogas production and VSS increased. This indicated that the reactor operation had stabilized. After this stabilization had occurred, the whey loadings were increased to obtain maximum loadings. Figures 5(b) and 5(e) show that as the whey feed was increased above 800 L/day, the VA/BA ratio increased, indicating unstable operation. Figure 5(a) shows that the maximum COD loading rate that was obtained during stable operation was 2.2 kg COD/m^3 digester volume which translates to a hydraulic retention time (HRT) of approximately 30 days. At these loading rates, a total COD reduction of 81.2% was achieved. In addition, the total BOD was reduced by 94.0% and the total solids by 77.6%. The total suspended solids increased from a concentration of 1,100 mg/L to 6,350 mg/L. This increase reflects the bacterial content in the reactor contents and the effluent.

Figures 5(g) and 5(h) show the biogas quality and daily biogas production. The maximum production reached was approximately 40 L/day, with the average production being 23.4 L/day. The biogas quality started with methane and carbon dioxide concentrations of approximately 50% and 40% respectively. The trend over time was a slow increase in the methane concentration, with a corresponding decrease in the carbon dioxide concentration. The final methane and carbon dioxide concentrations were 59.8% and 34.4%, respectively. The specific biogas production rate during the final steady state period averaged 0.63 m^3/kg COD removed/day.

Discussion

The operation of Reactor 1.0 for the period between October 1985 - March 1986 was considered quite successful as the COD loading rate of 2.2 kg COD/m^3 digester volume and the HRT of 30 days approached the full-scale design loadings of 2.95 kg COD/m^3 digester volume and the design HRT of 30 days.

The fact that stable operation was occurring after 40 days was very encouraging. Since this municipal digester supernatant was readily available from the City of Waterloo at no cost (except for hauling), it made implementation at full-scale very attractive in January 1986.

Reactor 2.0 - 10% Digested Swine Manure Addition

Reactor 2.0 was started up on September 24, 1985 (Day 1) using 25 litres of effluent from the full-scale digester as seed. The addition of digested swine manure was 10% of the whey fed daily.

Results

The data obtained from the operation of this reactor is included in Table B-2 in Appendix B, and summarized graphically in Figures 6(a) to 6(j). Figure 6(b) shows the volume of whey and digested swine manure added daily. At start-up, the whey feedrate was 400 mL/day. Figures 6(d) and 6(e) show that the VA/BA ratio increased and pH decreased immediately.

On days 29 and 30 (Oct. 22 and 23, 1985), Figure 5(b) shows the addition of digested swine manure was increased to 400 mL/day in an attempt to reverse the very high VA/BA ratio and low pH. The VA/BA ratio and the pH improved slightly, but not sufficiently. From Days 35 to 38 (Oct. 28 - 31) feeding was stopped. This caused the VA/BA ratio to fall from 3.96 to 1.48, and the pH to increase from 6.8 to 7.35. Figures 6(c) and 6(f) show that at the same time, the total solids (TS) and the total COD concentration decreased rapidly. Figure 6(j) indicated an increase in the total suspended solids (TSS) and the volatile suspended solids (VSS) concentrations.

As the feedrate was subsequently increased, the pH dropped slightly but eventually stabilized around 7.1. The VA/BA ratio, except for a small peak at Day 95 (Dec. 17) remained below 1 and declined with time even as the loading rate was increased significantly.

By March 1986, Figure 5(a) shows the COD loading rate to this reactor was 2.82 kg COD/m^3 which translates to a hydraulic retention time of 22.5 days. The reactor achieved a total COD reduction of 76.6%, a total BOD reduction of 89.2% and a total solids reduction of 74.1%, while the total suspended solids increased from 1,100 mg/L to 6,950 mg/L.

Figures 6(g) and 6(h) show the biogas quality and daily biogas production. The biogas production increased steadily over time, with the maximum being 55.5 L/day and an average of 40 L/day. At start-up, the methane and carbon dioxide content were 35% and 50%, respectively. When the feeding was stopped on Day 35 (Oct. 28), the methane content rose to 65% and the carbon dioxide content decreased to 25%. As the feeding re-commenced, the

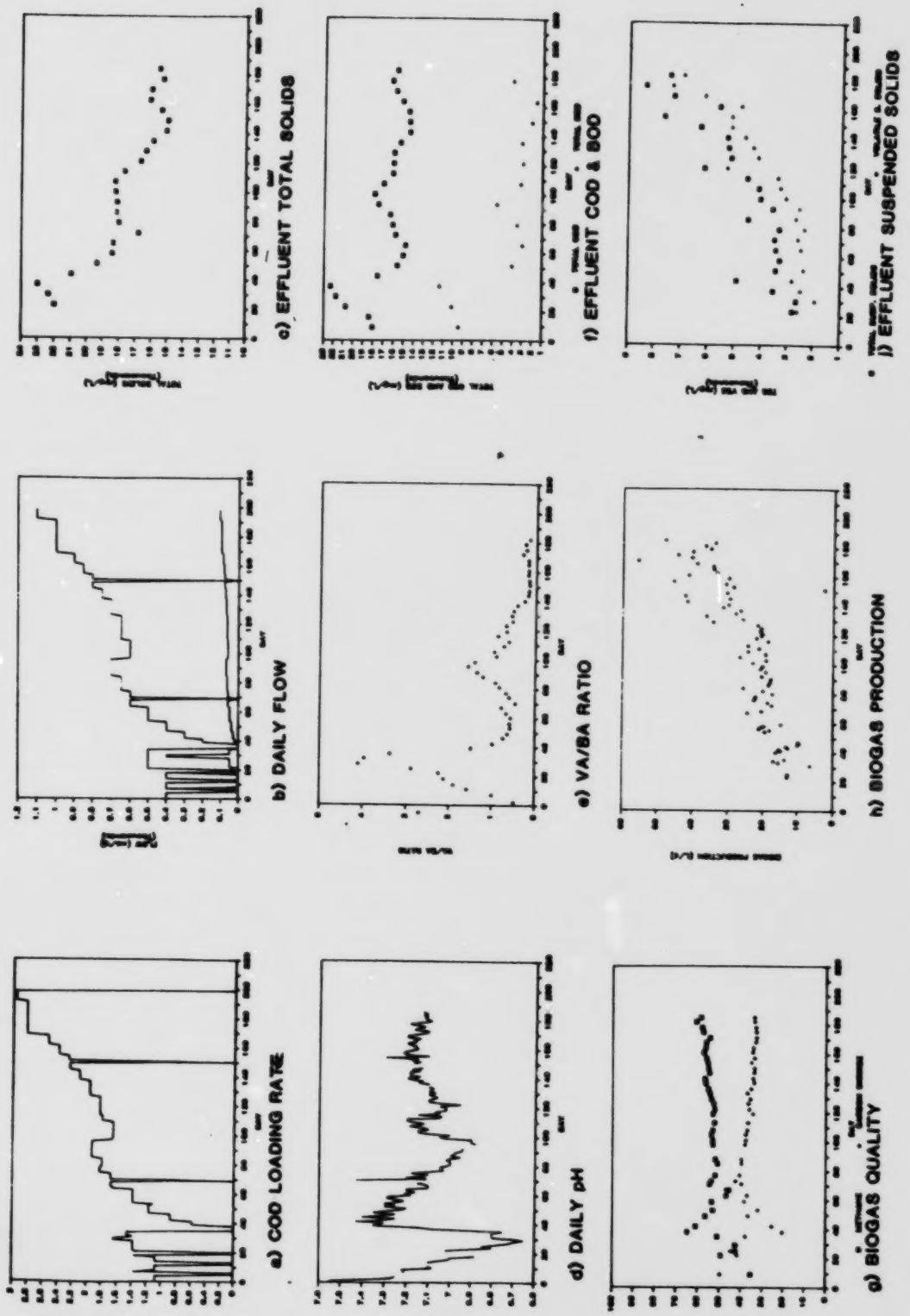


FIGURE 6: DATA SUMMARY FOR REACTOR 2.0

methane concentration decreased and the carbon dioxide concentration increased to parity at approximately 46%. For the duration of the monitoring period the methane concentration increased steadily to a maximum of 59.5%, while the carbon dioxide concentration decreased to 33.5%. The specific biogas production at the end of the monitoring period averaged 0.76 m^3/kg COD removed/day.

Discussion

The operation of Reactor 2.0 between September 1985-March 1986 was considered very successful as the loading rate of 2.82 kg COD/m^3 digester volume/day and the HRT of 22.5 days were essentially equal to the full-scale design loadings of 2.95 kg COD/m^3 digester volume/day at the HRT of 22 days.

However, as noted in the results, the start-up of this reactor was slower and more tedious than that of Reactor 1.0 and it was not until Day 90-Day 120 that stable operation was indicated.

Reactor #3.0 - 5% Digested Swine Manure Addition

Reactor 3.0 was started up on September 24, 1985 (Day 1) using 25 litres of effluent from the full-scale digester as seed. The addition of digested swine manure was 5% of the whey fed daily.

Results

The data obtained from the study for this reactor is provided in Table B-3 in Appendix B and summarized graphically in Figures 7(a) to 7(j). Figure 7(b) shows the volume of whey and digested swine manure added daily.

Initially, the whey fed was 400 mL/day. Figures 7(d) and 7(e) show that the VA/BA ratio increased and the pH decreased immediately. On Days 29 and 30 (Oct. 22 and 23, 1985), the addition of digested manure was increased to 200 mL/day (50% of feed) in an attempt to reduce the high VA/BA ratio and raise the pH. This had no effect on the VA/BA ratio and a little effect on the pH. On Day 35 (Oct. 28), the feeding was stopped. Between Day 35 (Oct. 28) and Day 39 (Nov. 1) the VA/BA ratio fell from a high of 9.89 to 2.15, and the pH increased from a low of 6.6 to 7.2. Figures 7(c) and 7(f) show that

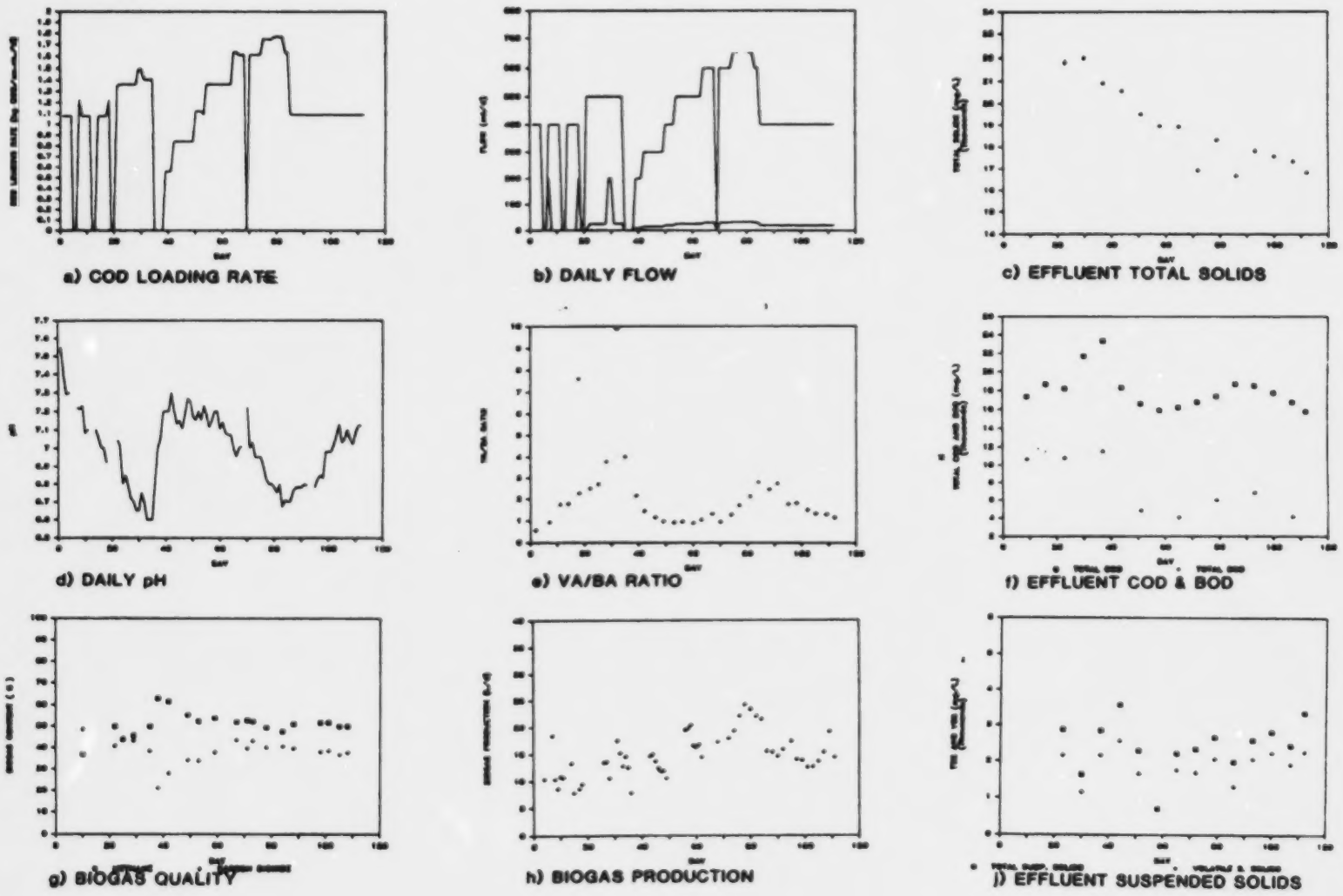


FIGURE 7: DATA SUMMARY FOR REACTOR 3.0

immediately following the cessation of feeding, the total COD concentration and the total solids concentration decreased. This was anticipated as the bacteria were expected to utilize the reactor contacts while no whey was being added. Figure 7(j) shows that the total suspended solids and volatile suspended solids concentration decreased. This was not expected as this suggests a decrease in the bacterial population.

There was a much less dramatic effect on the reactor as a result of the feeding being stopped, as compared to that experienced by Reactor 2.0 during the same time period. As a result, there was a less definite differentiation between the start-up period and the operational period. The total solids concentration continued to decrease over the complete monitoring period, and the total suspended solids and volatile suspended solids concentrations did not increase much above their initial values.

When the feeding was re-started, the pH began to decrease slowly to a low of 6.7 on Day 84 (Dec. 16). The VA/BA ratio increased to a high of 2.78 on the same day. The feedrate was decreased significantly from 650 mL/day on Day 82 (Dec. 14) to 600 mL/day on the two subsequent days, and a further decrease on Day 85 (Dec. 17) to 400 mL/day. This feedrate was maintained until January 13, 1986. The decrease in feedrate resulted in the pH rising to 7.0-7.1 and the VA/BA ratio falling to 1.14. Figure 7 (a) shows the COD loading rate at this time to be 1.09 kg COD/m^3 reactor volume, which translates to a HRT of 59.5 days. The total COD reduction was 76.6%, the total BOD reduction was 88.9%, and the total solids concentration reduction was 71.9%. The total suspended solids concentration increased from 1,100 mg/L to 3,350 mg/L.

Figures 7(g) and 7(h) show the biogas quality and the daily production. The biogas production slowly increased over time, with a maximum of 24.2 L/day and an average of 14.6 L/day at the final loading rate. At start-up, the methane and carbon dioxide concentrations were 37% and 49%, respectively. When the feeding was stopped on Day 35 (Oct. 28), the methane concentration rose to 62.8% and the carbon dioxide decreased to 20.9%. As the feeding recommenced the methane decreased and the carbon dioxide increased slowly for approximately 40 days (Days 40-80) after which there was a slow increase in the methane and a decrease in carbon dioxide. The final biogas composition was 49.8% methane and 37.5% carbon dioxide. The average specific biogas production was 0.74 m^3/kg COD removed per day.

Discussion

The operation of Reactor 3.0 was less successful than that of Reactors 1.0 and 2.0 as the COD loading of 1.09 kg COD/m^3 digester volume/day that was achieved does not approach the full-scale design loading of 2.95 kg COD/m^3 digester volume/day.

Based on the operation of Reactor 2.0 and Reactor 3.0, it is believed that the daily addition of 5% digested swine manure is simply not sufficient to allow the attainment of the full-scale design loadings.

Reactor #3.1 - Start-Up with Municipal Digester Supernatant as Seed

Reactor 3.1 was started-up with 20 litres of municipal digester supernatant on January 22, 1986 (Day 1), with daily additions of whey and 15% supernatant until a volume of 25 litres was reached. The digester was then fed whey plus 15% supernatant on a batch and fill basis. This was to determine if municipal digester supernatant in itself would be a satisfactory "seeding" substrate for start-up.

Results

The results obtained from the operation of Reactor 3.1 are provided in Table B-4 in Appendix B, and summarized graphically in Figures 8(a) to 8(j). Figure 8(b) shows the volume of whey and municipal digester supernatant added daily, the initial feeding rate was 200 mL/day. Figure 8(e) shows that initially the VA/BA ratio was very low at 0.23. As the feedrate was increased to 500 mL/day, Figure 5(e), the VA/BA ratio increased to 0.55 and Figure 8 (d) shows the pH decreased. The feedrate was decreased to 300 mL/day on Day 13 (Feb. 3) with the VA/BA ratio stabilizing again at 0.28. As the feedrate was again increased to 500 mL/day on Day 25 (Feb. 15) the VA/BA ratio began to increase approximately 10 days later, and continued to increase from 0.30 to 1.21 on Day 48 (Mar. 10). The feedrate was decreased to 400 mL/day on Day 50 (Mar. 11) with the VA/BA ratio reaching a maximum of 1.35 on Day 52 (Mar. 13). The ratio subsequently decreased slightly to an average of 1.16 at the end of the study period. During this period the pH decreased to a final value of 6.75.

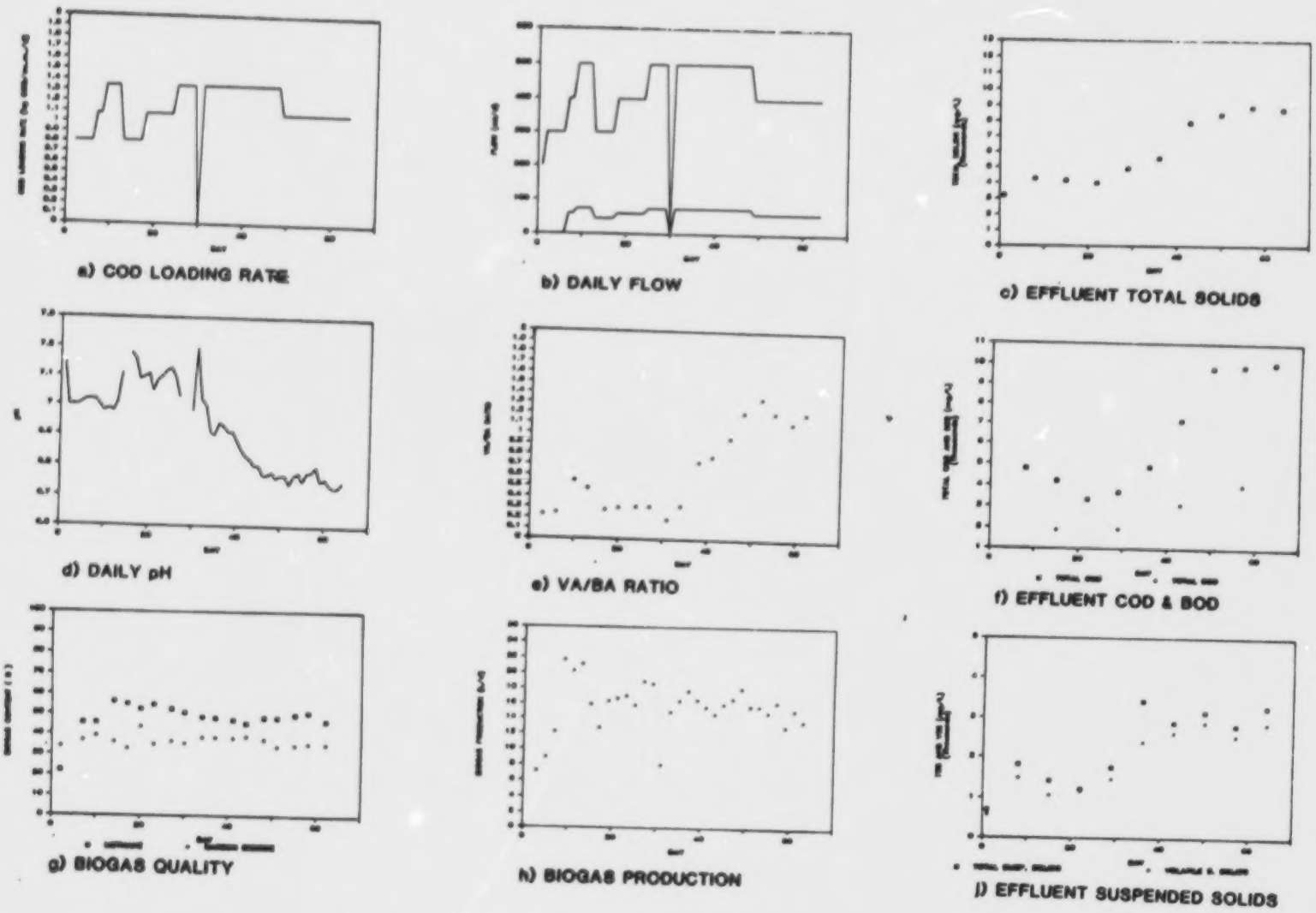


FIGURE 8: DATA SUMMARY FOR REACTOR 3.1

Figures 8(c), 8(f) and 8(j) show the total COD, total BOD total solids, total suspended solids and the volatile suspended solids concentrations increasing as operation of the reactor continued. By the end of March 1986, the data points suggest that some stabilization was occurring. However, there is insufficient data to show this conclusively.

At the end of March 1986, the final COD loading rate was 1.08 kg COD/m^3 volume, with an HRT of 54.4 days.

Figures 8(g) and 8(h) show the biogas quality and daily biogas production. The production varied considerably during the first 20 days, with some stability in the following days. The average production was 14 L/day. The biogas quality was initially very low with a composition of 22% methane and 34% carbon dioxide. At the end of the study period this had improved to 48.6% methane and 35.4% carbon dioxide.

Discussion

The results for Reactor 3.1 indicate that the use of municipal digester supernatant as a seed material would not be satisfactory. At best, its use would result in a very slow start-up.

Reactor #4.0 - 5% Digested Swine Manure Addition Plus NaOH (Caustic) for pH Control

Reactor 4.0 was started up on September 18, 1985 (Day 1), with 25 litres of effluent from the full-scale digester as seed. The addition of digested swine manure was 5% of the whey fed daily, with NaOH added to maintain a pH of 7.0-7.3.

Results

The results obtained from the study for this reactor are provided in Table B-5 in Appendix B and summarized graphically in Figures 9(a) to 9(j). Figure 9(b) shows the volume of whey, supplement and NaOH added daily. At start-up, the whey fed was 300 mL/day. Figures 9(d) and 9(e) show that the VA/BA ratio increased and the pH decreased immediately. On Day 16 (Oct. 3) NaOH was first added. The NaOH halted the rise of the VA/BA ratio in the range of 1.3-2.0, and caused the pH to increase. On Day 27 (Oct. 14)

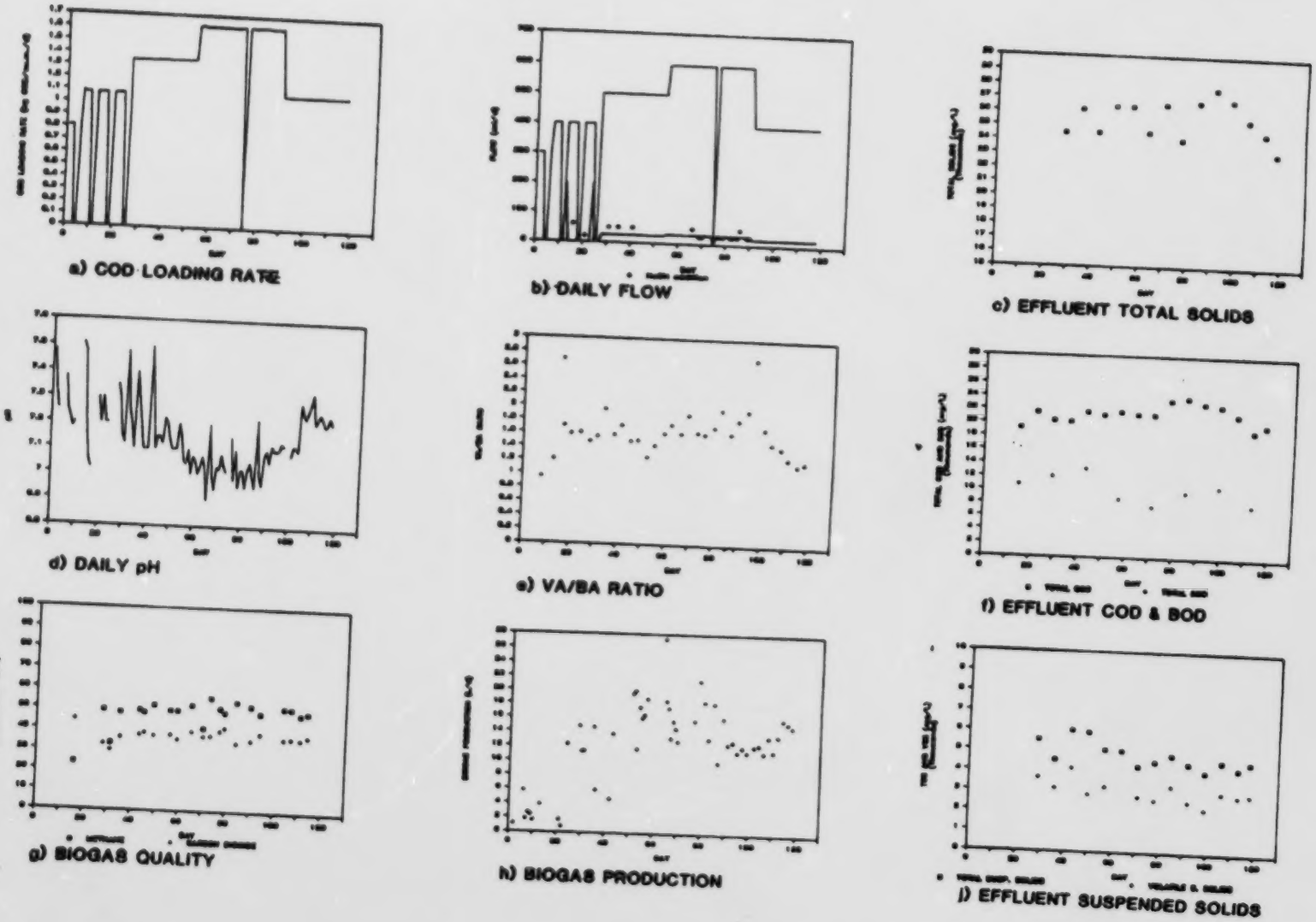


FIGURE 9: DATA SUMMARY FOR REACTOR 4.0

the feedrate was increased to 500 mL/day. Additions of NaOH were necessary to maintain the pH. The pH stabilized in the range of 7.1-7.2, and the VA/BA ratio began to decrease slightly. When the feedrate was increased to 600 mL/day, it became necessary to add NaOH almost daily. The VA/BA ratio stabilized in the range of 1.6-2.0. Figure 9(f) shows that the total COD and total BOD increased during this period of frequent NaOH addition. This indicated that the microorganisms may have been inhibited by the NaOH. The feedrate was subsequently reduced to 400 mL/day. This resulted in the pH increasing from 7.1 to 7.2 without NaOH addition. The VA/BA ratio at the same time decreased from 2.0 to 1.2. Figures 9(c) and 9(f) show the total solids concentration, total COD, and total BOD decreasing, indicating that the NaOH inhibition may not have been permanent. At these loadings, Figure 9(a) shows that the COD loading rate was 1.08 kg COD/m^3 volume which translates to an HRT of 59.5 days. Figure 9(j) shows the total suspended solids concentration increased from 1,100 mg/L (whey feed) to 4,500 mg/L (reactor effluent).

Figures 9(g) and 9(h) show the biogas quality and daily biogas production. The biogas production was initially very low at 1 to 5 L/day, then it increased significantly in the following days to a maximum of 27 L/day, with an average, at the final loading rate, of 15.5 L/day. The addition of NaOH corresponds with a drop in the biogas production which may be evidence of NaOH inhibition. At start-up, the methane and carbon dioxide contents of the biogas were 24% and 45%, respectively. The methane content increased and the carbon dioxide content decreased with time. The final methane and carbon dioxide contents were 49.2% and 37.9%, respectively. The specific biogas production rate at the end of the monitoring period averaged 0.76 m^3/kg COD removed/day.

Discussion

The results for Reactor 4.0 showed that a combination of 5% digested swine manure and caustic for pH control were not suitable as a nutrient/buffer supplement addition at full-scale as the loadings did not approach the full-scale design loading.

The loadings obtained were no higher than those for Reactor 3.0 indicating that the caustic provided no benefit to this reactor. When the whey feed was increased above 400 mL/day and caustic was required to maintain the pH, the effluent BOD and COD increased and the biogas production dropped which indicated unstable operation within the reactor.

Reactor #4.1 - Start-up with Municipal Digester Supernatant and Reactor #1.0 Effluent as Seed

Reactor 4.1 was started up with 17 litres of municipal digester supernatant and 3 litres of effluent from Reactor 1.0 on January 22, 1986 (Day 1). Whey and supernatant were then added until a volume of 25 litres was reached. The digester was then fed whey plus 15% supernatant.

Results

The data obtained from the monitoring of this reactor is provided in Table B-6 in Appendix B and summarized graphically in Figures 10(a) to 10(j). Figure 10(b) shows the volume of whey and supplement added daily. At start-up, the whey feedrate was 200 mL/day. The VA/BA ratio was below 0.1 and the pH was 7.15. Figures 10(d) and 10(e) that as the feedrate was increased to 1,000 mL/day the VA/BA ratio remained virtually unchanged and the pH stayed in the range of 6.9-7.1 until March 26, 1986 (Day 64). Figures 10(c), 10(f) and 10(j) show an almost linear increase in the total COD, total BOD, total solids, total suspended solids, and the volatile suspended solids concentration. This indicates that while the pH and VA/BA indicated stable operation there may indeed have been some instability within the reactor. This suspicion of instability was also based on the fact that it was never possible to achieve a whey feedrate greater than 800 mL/day in Reactor 1.0. At Day 64, Figure 10(a) shows the COD load rate to be 2.7 kg COD/m^3 digester volume/day.

Figures 10(g) and 10(h) show the biogas quality and daily biogas production. The biogas increased rapidly over time reaching a maximum of 39.4 L/day, with an average of 34.1 L/day at the maximum feedrate. At start-up the methane and carbon dioxide contents were 43.7% and 29.7%, respectively. The methane content increased with time. The carbon dioxide content initially increased but then decreased slowly. The final methane and carbon dioxide contents were 56.9% and 31.3%, respectively.

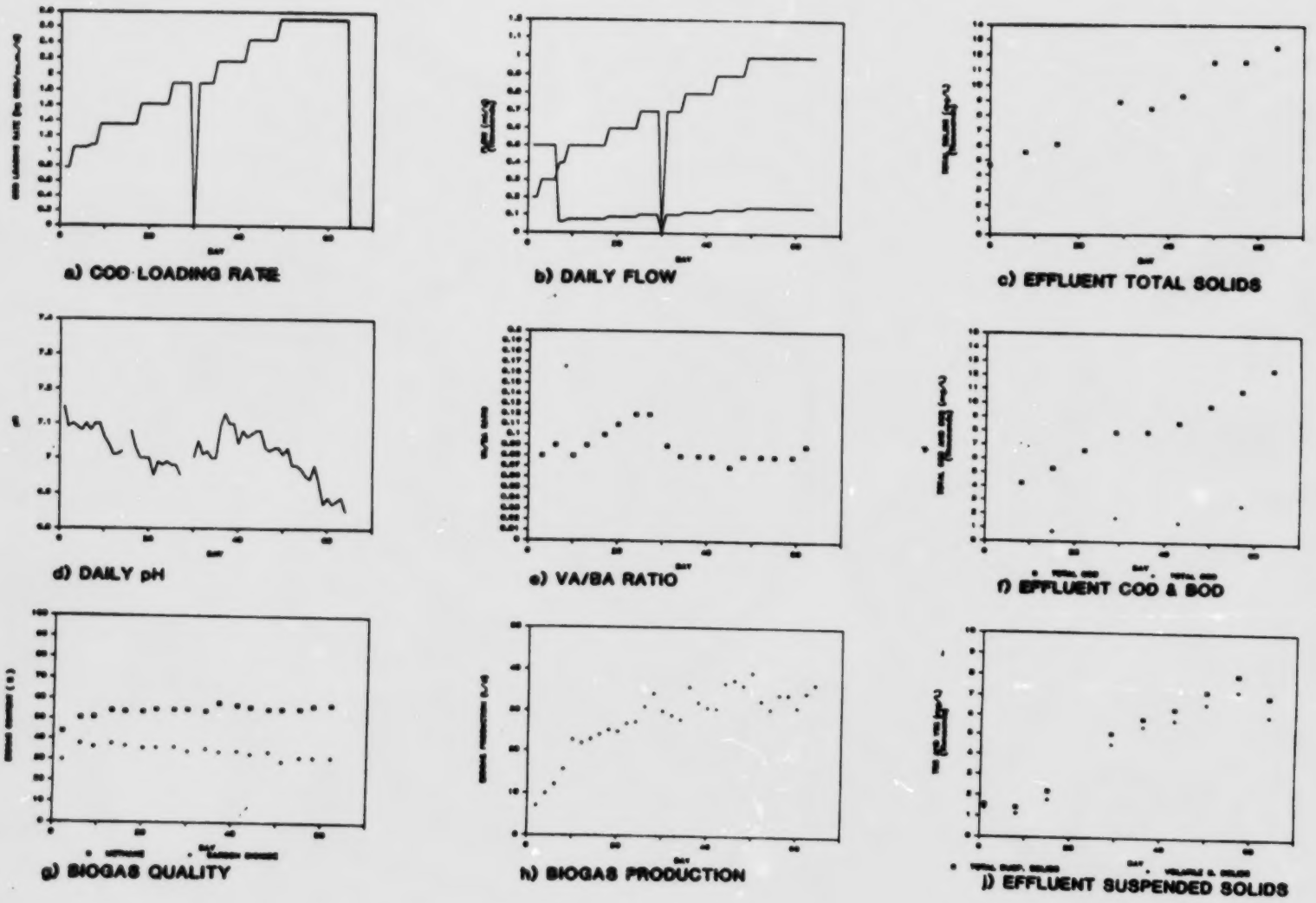


FIGURE 10: DATA SUMMARY FOR REACTOR 4.1

Discussion

This reactor was very quick to start up when compared to Reactor #3.1. This indicated that if it were ever necessary to shut off and/or empty the full-scale digester that some seed material in addition to municipal digester supernatant would be required to provide a faster start-up.

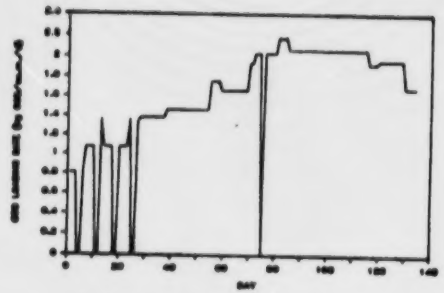
Further study was considered necessary to determine if the COD loading rate of 2.7 kg COD/m^3 digester volume/day would be maintained or if the reactor operation had in fact become unstable when the whey loading was increased above 800 mL/day. It was suspected that the reactor was unstable as Reactor 1.0 had never attained loadings this high.

Reactor #5.0 - 10% Digested Swine Manure Addition Plus Caustic for pH Control

Reactor 5.0 was started up on September 18, 1985 (Day 1), using 25 litres of effluent from the full-scale digester as seed. The supplement addition was 10% digested swine manure with caustic (NaOH) added to maintain a pH of 7.0-7.3.

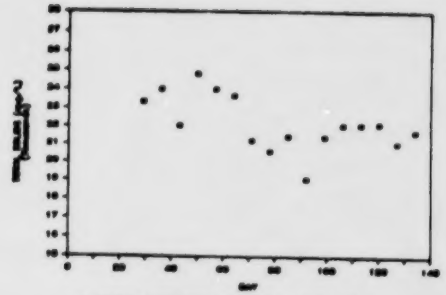
Results

The data obtained from Reactor 5.0 is provided in Table B-7 in Appendix B and summarized graphically in Figures 11(a) to 11(j). Figure 11(b) shows the volume of whey, digested swine manure (supplement) and NaOH added daily. At start-up the whey fed was 300 mL/day. Figures 11(d) and 11(e) show that the VA/BA ratio increased and the pH decreased at start-up. The VA/BA ratio continued to rise reaching 2.24 on Day 17 (Oct. 4). On Day 17 and on Day 20, caustic was added and the VA/BA ratio subsequently decreased. It was during this period that the supplement was being added approximately every 10 days. Beginning on Day 28 (Oct. 15), the supplement was added daily. The additions of NaOH on Days 35 and 41 (Oct. 22 and 28) corresponded with a subsequent drop in the VA/BA ratio, while there was no change in the feed or supplement rate. This suggested that the initial addition of NaOH can reduce the VA/BA ratio along with controlling the pH. As the feedrate was increased from 500 mL/day to 600 mL/day, and later to 700 mL/day, the VA/BA ratio continued to fall and eventually stabilized in the 0.8-1.2 range. The pH remained between 7.0-7.3 without any further addition of NaOH. On Day 81 (Dec. 7) the feedrate was increased to 750 mL/day. The

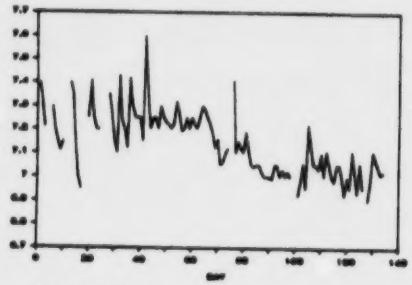


a) COD LOADING RATE

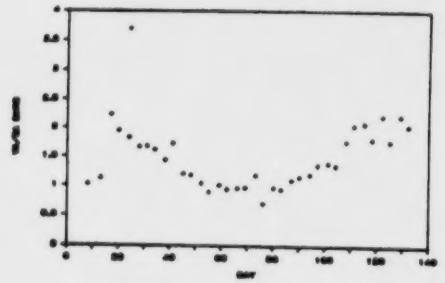
b) DAILY FLOW



c) EFFLUENT TOTAL SOLIDS

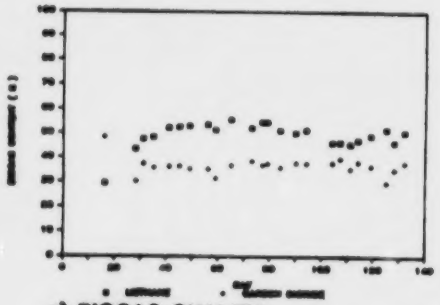


d) DAILY pH

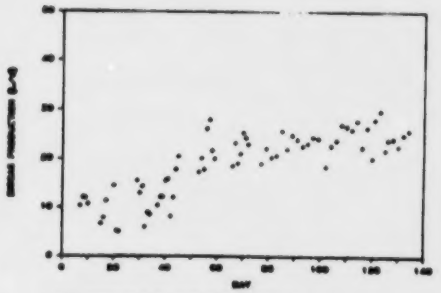


e) VA/BA RATIO

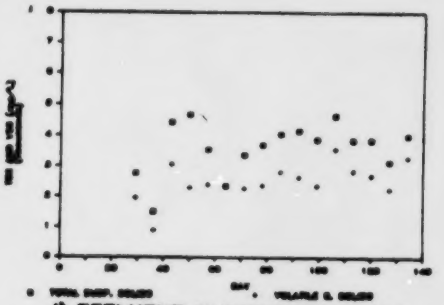
f) EFFLUENT COD & BOD



g) BIOGAS QUALITY



h) BIOGAS PRODUCTION



j) EFFLUENT SUSPENDED SOLIDS

FIGURE 11: DATA SUMMARY FOR REACTOR 5.0

VA/BA ratio continued to increase despite the additions of NaOH. Figure 11(f) shows that, between Days 80-120 (Dec. 6 - Jan. 15), the total COD and total BOD increased. This indicates that the reactor was becoming less efficient. Figure 11(j) shows that at the same time the volatile suspended solids decreased, indicating a possible reduction in the bacterial population. The decrease in the bacterial population may have been due to the washout of the bacteria by the increased hydraulic loading, or by a toxic effect caused by the frequent addition of NaOH. The feedrate was decreased to 600 mL/day on Day 130 (Jan. 25). The last data points in Figures 11(f) and 11(j) show that the total COD and total BOD had decreased, and that the total suspended solids and volatile suspended solids had increased. This suggests that the reactor was returning to stable operation. This reactor was shut down on January 29, 1986. At this time, Figure 11(a) shows the COD loading rate was 1.68 kg COD/m^3 reactor volume, which translates to an HRT of 37.9 days. The total COD reduction was 68.8%, the total BOD reduction was 80.2%, and the total solids concentration reduction was 63.7%. The total suspended solids increased from 1,100 mg/L to 3,300 mg/L.

Figures 11(g) and 11(h) show the biogas quality and daily biogas production. At start-up the methane and carbon dioxide contents were 29% and 48%, respectively. The methane content increased over time, with a maximum of 55.6% on Day 65 (Nov. 21). This maximum corresponds with one of the lowest VA/BA ratios. The methane content decreased as the feedrate was increased to 750 mL/day and the NaOH was added. The methane content began to rise quickly as the feedrate was decreased and the NaOH additions were stopped. The carbon dioxide content decreased from its initial 49%, and remained steady throughout the study period. The final methane and carbon dioxide contents were 50.5% and 38.0%, respectively. The biogas production increased steadily over time, reaching a maximum of 29.8 L/day, with an average at steady state of approximately 24.1 L/day. The average steady state specific biogas production rate was 0.74 m^3/kg COD removed/day.

Discussion

The results for Reactor 5.0 show that, as was the case for Reactor 4.0, the addition of caustic had no positive effect on this reactor's operation. In fact, there was some evidence that the caustic addition was detrimental to the reactor's overall performance.

Reactor #5.1 - Full-Scale Duplication

Reactor 5.1 was started up on February 1, 1986 (Day 1), using 25 litres of effluent from the full-scale digester as seed. The daily addition of whey and the municipal digester supernatant supplement from Day 1 on were equivalent to those received by the full-scale digester.

Results

The results obtained for Reactor 5.1 are provided in Table B-8 in Appendix B, and summarized graphically in Figures 12(a) to 12(j). Figure 12(b) shows the volume of whey, and supplement added daily. The whey fed varied considerably, with an average of 292 mL/day and an average supplement addition of 62 mL/day, which is equal to 21% of the whey fed. Figure 12(d) shows the VA/BA ratio decreased from the initial value of approximately 1.0 to a low of 0.27 on Day 21 (Feb. 21). The ratio subsequently increased and fluctuated in the range of 0.3-0.7.

Figure 12(c), 12(f) and 12(j) show that the total COD, total BOD and total solids concentration decreased, while the total suspended solids and volatile suspended solids concentration increased over the length of the study period. This indicates improved operation as compared to the initial seed, which was from the full-scale digester. At the end of the study period, the average COD loading rate was 0.82 kg COD/m^3 volume, the HRT was 88.3 days, the total COD reduction was 88.6%, the total OD reduction was 95.8%, and the total solids concentration reduction was 85.2%.

Figures 12(g) and 12(h) show the biogas quality and daily biogas production. The initial methane and carbon dioxide contents of the biogas were 52% and 38% respectively. This remained fairly constant throughout . The final biogas content was 56.3% methane and 35.6% carbon dioxide.

Discussion

The operation of Reaction 5.1 was very stable when receiving whey and municipal digester supernatant supplement in amounts equalivent to those being received at full-scale. The operation of the full-scale system for this time period will be discussed in a subsequent section. However, it is noted here that the operation in Reactor 5.1 was superior to that experienced at full-scale.

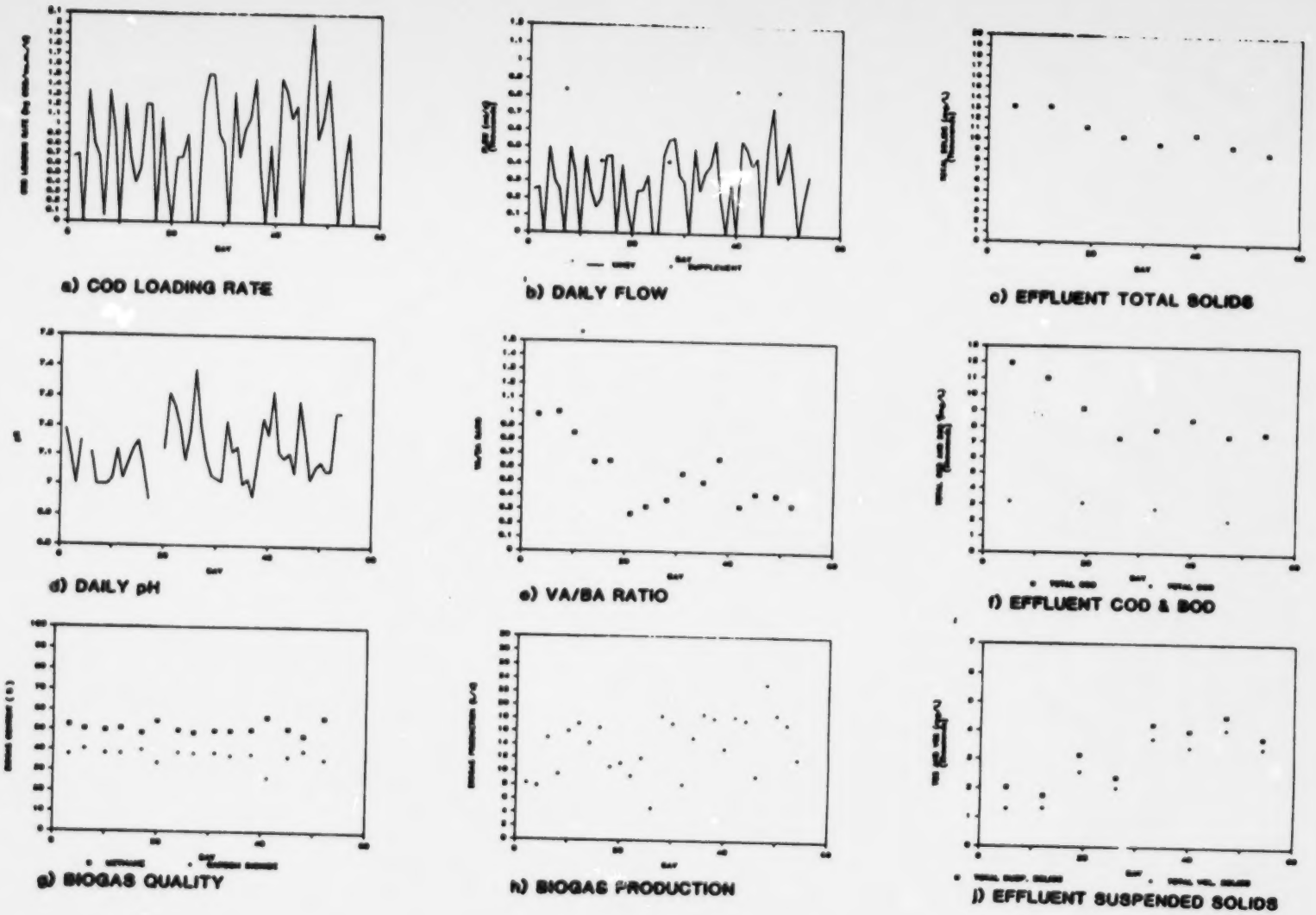


FIGURE 12: DATA SUMMARY FOR REACTOR 5.1

Reactor #6.0 - 10% Digested Swine Manure at 55°C

Reactor 6.0 was started up on September 18, 1985 (Day 1) using 25 litres of effluent from the full-scale digester as seed. The supplement addition was 10% digested swine manure. This reactor was operated thermophilically at 55°C.

Results

The results for Reactor 6.0 are provided in Table B-9 in Appendix B, and summarized graphically in Figures 13(a) to 13(j). Figure 13(b) shows the volume of whey and supplement added daily. At start-up, the feedrate was 300 mL/day. Figures 13(d) and 13(e) show that the pH decreased immediately after start-up and the VA/BA ratio increased. On Day 31 (Oct. 18) the pH was 6.75 and VA/BA ratio was 4.99. The feeding of the digester was stopped for the following 6 days to allow stabilization to occur. As a result, the VA/BA ratio decreased to 3.69, and the pH increased from 6.58 to 7.2. On Day 38 (Oct. 25) the feeding was re-started at 200 mL/day. Figure 13(f) shows that the total COD and total BOD decreased rapidly in the days following. Figure 13(g) shows the biogas quality improved significantly during this period.

As the feedrate was again increased, the VA/BA ratio increased to above 2.0 and the pH decreased from 7.6 to 7.1. Under mesophilic conditions, this would have indicated unstable reactor operation. However, the biogas quality and production remained steady, and the total solids concentration continued to decrease. While the primary operational parameters of VA/BA and pH suggested instability, the secondary operational parameters indicated little, if any, upset. The feedrate was therefore reduced only slightly, from 700 mL/day to 600 mL/day, with time allowed for the stabilization of the primary parameters. From approximately Day 110 (Jan. 5) the VA/BA ratio began to decrease, while the pH stabilized in the range of 7.3-7.4. The total COD and the total solids concentration decreased, while the total suspended solids, volatile suspended solids concentration, and biogas production increased. Very stable operation was evident and the feedrate was increased in successive steps to a final feedrate of 800 mL/day.

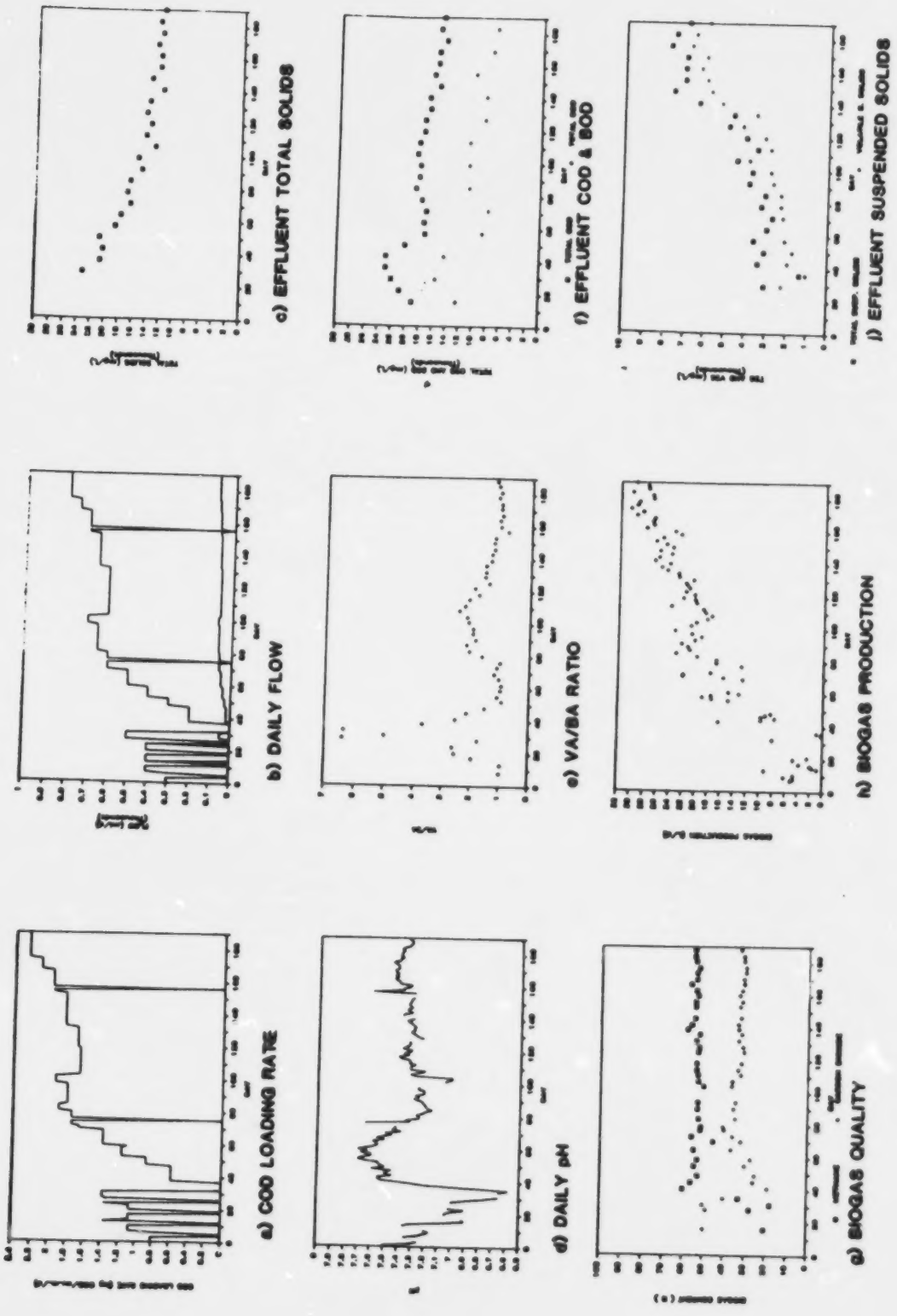


FIGURE 13: DATA SUMMARY FOR REACTOR 6.0

On March 26, 1986, Figure 13(a) shows that the COD loading rate was 2.25 kg COD/m^3 reactor volume which translates to an HRT of 28.4 days. At this time, the total COD reduction was 77.5%, the total BOD reduction was 81.3%, and the total solids concentration reduction was 80.2%. The total suspended solids concentration increased from 1,100 mg/L (whey feed) to 6,950 mg/L.

Figures 13(g) and 13(h) show the biogas quality and daily biogas production. The initial methane and carbon dioxide contents were 21% and 50%, respectively. The final biogas content was 55% methane and 33% carbon dioxide. The biogas production increased steadily over the length of the study period. The average production at the end of the study period was 28.8 L/d. The final average specific biogas production was 0.66 m^3/kg COD removed·day.

Discussion

The loadings attained by Reactor 6.0 (at 55°C) were essentially the same as those attained for Reactor 2.0 (at 35°C) during the same time period. This indicated that there was no real benefit to operating in the thermophilic temperature range and consequently this was not given any further consideration.

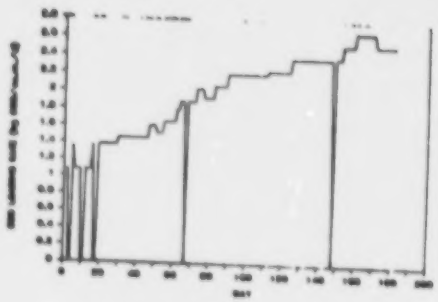
One interesting aspect of the work at 55°C was that the elevated temperature seemed to increase the operating pH approximately 0.3 above what was observed at mesophilic operation.

Reactor #7.0 - Fixed Film Reactor with 10% Digested Swine Manure Addition

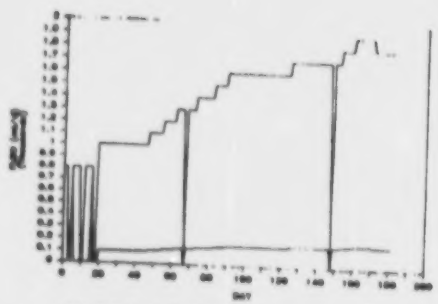
Reactor 7.0 (the 50 L fixed film reactor) was started up on September 26, 1985 (Day 1) with 50 litres of effluent from the full-scale digester as seed. The supplement addition was 10% digested swine manure.

Results

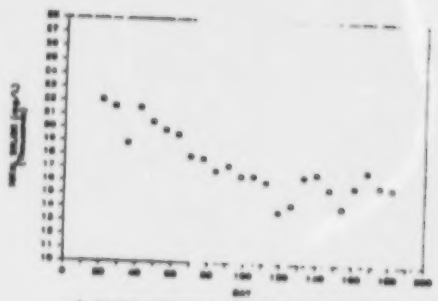
The results for Reactor 7.0 are provided in Table B-10 in Appendix B, and summarized graphically in Figures 14(a) to 14(j). Figure 14(b) shows the volume of whey and supplement added daily. At start-up, the feedrate was 800 mL/day. Figures 14(d) and 14(e) show that the VA/BA ratio increased to 2.63 and the pH decreased to 6.84 on Day 37 (Nov. 1) when the whey fed was 1,000 mL/day.



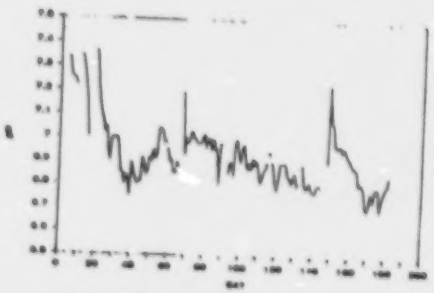
a) COD LOADING RATE



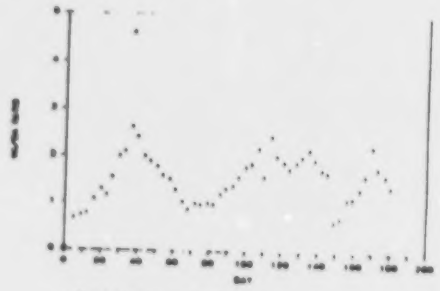
b) DAILY FLOW



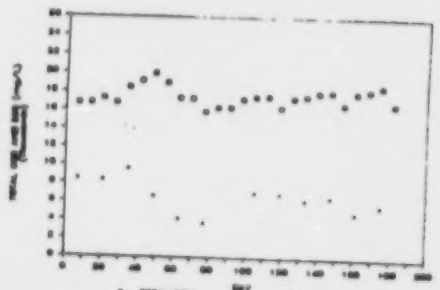
c) EFFLUENT TOTAL SOLIDS



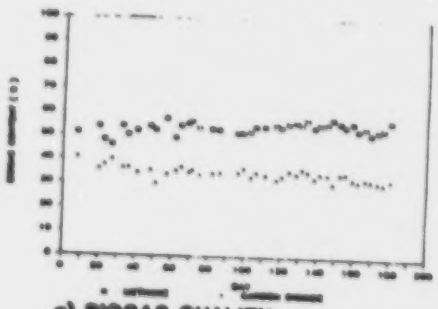
d) DAILY pH



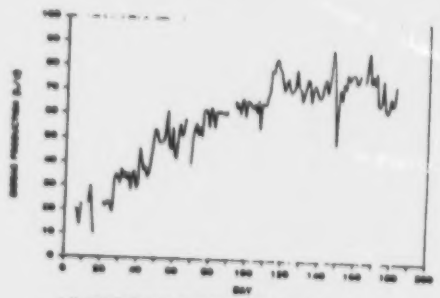
e) VA/BA RATIO



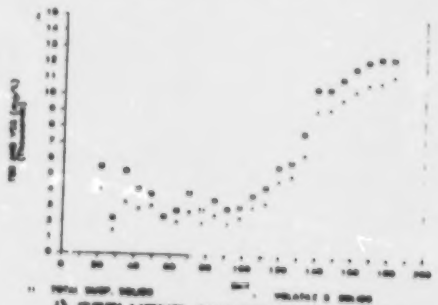
f) EFFLUENT COD & BOD



g) BIOGAS QUALITY



h) BIOGAS PRODUCTION



j) EFFLUENT SUSPENDED SOLIDS

FIGURE 14: DATA SUMMARY FOR REACTOR 7.0

Consequently, the whey fed was maintained at 1,000 mL/day until the VA/BA ratio decreased and the pH increased. The whey fed was increased in increments until the feedrate reached 1,900 mL/day. This feedrate proved too high as the pH dropped and the VA/BA ratio increased very rapidly. At this point, the feedrate was reduced to 1,800 mL/day, causing the VA/BA ratio and the pH to stabilize.

Figure 14(a) shows that the final COD loading rate at the whey feedrate of 1,800 mL/day was 2.56 kg COD/m^3 digester volume which translates to an HRT of 25.3 days. On March 26, 1986 the total COD reduction was 74.9%, the total BOD reduction was 84.5%, and the total solids concentration reduction was 73.8%. The total suspended solids concentration increased to 12,500 mg/L.

Figures 14(g) and 14(h) show the biogas quality and daily biogas production. The biogas content was initially 51% methane and 41% carbon dioxide. This slowly improved to a final content of 57% methane and 33% carbon dioxide. The biogas production increased over time, reaching a maximum of 87.9 L/day, with an average, at the maximum stable loading rate, of 66.3 L/day. The average specific biogas production rate was 0.71 m^3/kg COD removed.

Discussion

The loadings achieved with the fixed film reactor (Reactor 7.0) were similar to those achieved with the complete mix reactor (Reactor 2.0). Since this was the case, further study of this reactor was not pursued as its implementation at the existing full-scale Millbank cheese plant would be very expensive.

It is interesting to note that the suspended solids concentration within the fixed film reactor is approximately double that of the complete mix reactor. However, this did not allow for increased loadings as some of the literature suggested.

2.4.3 Continued Laboratory-Scale Reactor Monitoring (April - June 1986)

The laboratory-scale reactor program discussed in the previous section was scheduled to end on March 26, 1986. However, there were many question which still remained unanswered at this time which included:

1. The effect of weekly addition of supplement (digester supernatant or digested swine manure) as opposed to daily additions.
2. The effect of reducing the percentage of the municipal digester supernatant addition or the digested swine manure supplement addition.
3. The highest attainable loading rates at lab-scale.
4. The effect of loading the reactors 6 days a week as opposed to 7 days a week.
5. The reason why the full-scale reactor had not attained the loadings achieved at lab-scale.

At this time, a decision was made to continue operation of 3 of the lab-scale reactors at CANVIRO's laboratory in Kitchener, Ontario until June 1986 in an attempt to answer some of the above questions.

Table 4 summarizes the reactor selection process used to determine which of the three reactors would be selected for continued monitoring at CANVIRO's laboratory. The reactors selected were comprised of:

1) Reactor #1.0 - 15% daily addition of municipal digester supernatant.
2) Reactor #2.0 - 10% daily additions of digested swine manure.
3) Reactor #4.1 - 15% daily additions of municipal digester supernatant.

TABLE 4. SUMMARY OF REACTOR SELECTION PROCESS FOR CONTINUED LAB-SCALE OPERATION

REACTOR NO.	COD LOADING RATE kg COD/m^3 vol.	HRT (day)	SELECTED OR REJECTED	REASON FOR SELECTION/REJECTION
1.0	2.2	27.2	Selected	Higher Loading Rate Ease of Implementation at Full-Scale
2.0	2.82	22.5	Selected	Higher Loading Rate
3.0	1.09	59.5	Rejected	Lower Loading Rate
3.1	1.08	54.4	Rejected	Lower Loading Rate
4.0	1.08	59.5	Rejected	Lower Loading Rate
4.1	2.7	21.7	Selected	Higher Loading Rate Ease of Implementation at Full-Scale
5.0	1.68	37.9	Rejected	Lower Loading Rate
5.1	0.82	68.3	Rejected	Expensive to Implement at Full-Scale
6.0	2.25	28.4	Rejected	Same as 6.0
7.0	2.54	25.3	Rejected	

During the continued monitoring from April-June 1986, several operating parameters were varied to determine their effect on reactor performance. These included:

i) Loading rates were increased to determine the maximum rate achievable, while maintaining stable operation.

ii) The volume of supplement (municipal digester supernatant or digested swine manure) was varied to determine if smaller additions would achieve similar results.

iii) The frequency of supplement additions was changed from once a day to an equivalent volume added once a week in an attempt to simulate the operation of the full-scale digester which received weekly additions of supplement.

iv) The frequency of whey additions was decreased from 7 days a week to 6 as the full-scale operation was seldom fed whey on Sunday.

The continued monitoring of Reactors 1.0, 2.0 and 4.1 from April through June 1986 is discussed in the following:

Reactor #1.0 - Municipal Digester Supernatant Addition

A summary of the results of the continued monitoring program for Reactor 1.0 is presented in Table 5. More detailed data is given in Table B-1 in Appendix B.

TABLE 5. SUMMARY OF RESULTS FOR CONTINUED LAB-SCALE OPERATION OF REACTOR 1.0

DATE	WHEY LOADING (mL/day)	DIGESTER SUPERNATANT ADDITION & FREQUENCY (% of whey fed)	VA/BA	COD (mg/L)	pH	REACTOR OPERATION
Prior to March 31	800	15 (daily)	0.15	12,188	6.93	Stable
April 1 - 17	850	15 (daily)	0.67	12,890	6.78	Unstable
April 18 - 24	700	15 (daily)	0.23	12,570	6.95	Stabilizing
April 25 - May 22	800	10	2.87	18,004	6.41	Unstable

This reactor had been operating at a feedrate of 800 mL whey per day prior to March 26, 1986 when the reactors were relocated to CANVIRO's laboratory. The loading rate was increased to 850 mL/day with 15% daily municipal digester additions on April 1, 1986. After two weeks, the VA/BA ratio and effluent COD had increased and the pH had decreased indicating that the reactor had become unstable. The loading was subsequently reduced to 700 mL/day for one week and the reactor stabilized.

The loading rate was then increased to 800 mL/day and the daily supernatant addition was decreased from 15% to 10%. The supernatant addition was reduced to determine if the whey loading of 800 mL/day could be maintained with less supplement. After one week of operation at the reduced

level of supernatant, there was no change in reactor stability. In the following three weeks the VA/BA ratio and reactor effluent COD increased considerably and pH decreased, indicating that the reactor had become unstable. The reduction in the rate of supplement addition was believed responsible for this.

The continued monitoring of Reactor #1.0 indicate the following:

1. The maximum whey feedrate with 15% daily digester supernatant addition was 800 mL/day which corresponds to a COD loading rate of 2.2 kg COD/m^3 volume.
2. Reducing the percentage of digester supernatant daily from 15% to 10% at loadings of 800 mL/day caused the reactor to become unstable.

Reactor #2.0 - Digested Swine Manure Addition

A summary of the results of the continued monitoring program for Reactor 2.0 is presented in Table 6. More detailed data is given in Table B-2 in Appendix B.

TABLE 6. SUMMARY OF RESULTS FOR CONTINUED LAB-SCALE OPERATION OF REACTOR 2.0

DATE	WHEY LOADING & FREQUENCY (mL/day)	DIGESTED ADDITION & FREQUENCY (% of whey fed)	VA/BA	COD (mg/L)	pH	REACTOR OPERATION
Prior to March 31	1,000 (daily)	10 (daily)	0.02	15,220	7.08	Stable
April 1 - 24	1,100 (daily)	10 (daily)	0.06	15,570	7.10	Stable
April 25 - May 31	1,200 (daily)	10 (daily)	0.08	17,447	7.2	Stable
June 1 - 26	1,200 (6 days/wk)	10 (once per week)	0.79	14,738		Less Stable

At the end of March 1986, Reactor 2.0 was operating stably at a loading rate of 1,000 mL/day. After the reactors were relocated, the loading rate was increased to 1,100 mL/day with 10% daily additions of digested swine manure. After three weeks of operation to April 24, 1986 the VA/BA ratio and the reactor effluent COD had decreased and the pH had increased, indicating that the reactor was still stable.

Subsequently, the loading rate was again increased by 100 mL/day to 1,200 mL/day. After five weeks of operation between April 25 and May 31, 1986 there was still no charge in the VA/BA ratio, COD and pH. Attempts to further increase this reactor's loading were not were not undertaken at this time. It was decided to attempt more closely to mirror the operation conditions of the full-scale digester to which supplement could only be added economically once per week. On June 1, 1986, the whey was fed only 6 days per week at the same rate of 1,200 mL/day. However, the addition of 10% digested swine manure was carried out weekly as opposed to daily.

By June 26, 1986 the VA/BA ratio had increased from less than 0.1 to 0.79 indicating less stable operation.

The results of the continued monitoring of Reactor 2.0 indicate the following:

1. The highest attainable whey load to this reactor with 10% daily addition of digested swine manure was at least 1,200 mL/day which is equivalent to a COD loading rate of 3.3 kg COD/m^3 volume and an HRT of 20.8 days (This exceeds to the original design loadings).
2. Weekly addition of 10% digested swine manure as opposed to daily additions had a negative effect on the reactor's operation. The maximum daily whey loading with once per week digested manure additions would be less than 1,200 mL/day.

Reactor #4.1 - Municipal Digester Supernatant Addition

A summary of the results of the continued monitoring program for Reactor 4.1 is presented in Table 7. More detailed data is provided in Table B-6 in Appendix B.

TABLE 7. SUMMARY OF RESULTS FOR CONTINUED LAB-SCALE OPERATION OF REACTOR 4.1

DATE	WHEY LOADING & FREQUENCY (mL/day)	DIGESTER SUPERNATANT ADDITION & FREQUENCY (% of whey fed)	VA/BA	COD (mg/L)	pH	REACTOR OPERATION
Prior to March 31	1,000 (daily)	15 (daily)	0.07	11,796	7.08	Stable
April 1 - 22	1,000 (daily)	10 (weekly)	1.17	13,440	6.46	Unstable
April 23 - 27	-	-	0.31	5,090	7.15	Stabilizing
April 28 - May 7	700 (daily)	10 (weekly)	0.51	5,695	6.80	Stable
May 8 - 16	800 (daily)	10 (weekly)	1.83	10,956	6.63	Unstable
May 17 - 19	-	-	0.14	11,469	7.07	Stabilizing
May 20 - June 4	700 (6 days/wk)	10 (weekly)	0.09			Stable
June 4 - 26	800 (6 days/wk)	10 (weekly)	0.11	10,423		Stable

At the end of the monitoring program in March, Reactor #4.1 was operating at a loading rate of 1,000 mL/day with 15% daily municipal digester supernatant additions. This daily whey loading was continued for three weeks until April 22, 1986 with 10% weekly additions of municipal digester supernatant. By April 22, 1986, the VA/BA ratio was 1.17 and the pH had dropped to 6.46 indicating very unstable operation.

Between April 23 and 27, feeding was discontinued and the reactor was allowed to stabilize. Daily feeding of 700 mL/day of whey with 10% weekly addition of supernatant began on April 28, 1986. The reactor operation was stable at this loading and the whey feedrate was increased to 800 mL/day on May 8, 1986. By May 16, 1986, the reactor's operation had become unstable. Between May 17-19 the reactor was again allowed to stabilize, and on

May 20, 1986 whey was fed to the reactor 6 days per week at a daily rate of 700 mL/day with 10% weekly additions of digester supernatant. The whey feed was increased to 800 mL/day 6 days per week on June 4 and continued to June 26, 1986 without any apparent negative effects.

The results of the continued operation of Reactor 4.1 indicated the following:

1. Whey digestion at whey loadings of 800 mL/day (equivalent to 2.2 kg COD/m^3 volume) is not achievable with 10% daily additions of municipal digester supernatant.
2. Reactor operation with 7 day/week whey additions of 700 mL/day whey plus 10% weekly municipal digester supernatant addition is stable, but unstable with 7 day/week whey additions of 800 mL/day.
3. Reactor operation at 6 day/week whey additions of 800 mL/day plus 10% weekly addition of municipal digester supernatant is stable.
4. Based on the above, it is suspected that had the 15% daily supplement addition been continued in April 1986 that the reactor operation would have become unstable. However, this was not confirmed.

2.5 Task 4: Optimizaton and Monitoring of the Full-Scale System (September 1985 - August 1986)

2.5.1 General

The operation and monitoring program for the full-scale anaerobic digester was originally scheduled to end in March 1986 (similar to the laboratory-scale program). However, this program was extended to August 1986 for several reasons including:

i) The fact that there was only a minimal amount of whey fed to the digester during the period between December 1985 and February 1986 when two of the three digester mixers were removed for repairs. Consequently, the data obtained during this period was of little use.

ii) The fact that the maximum loadings attained by the full-scale digester were significantly less than those achieved at laboratory-scale.

iii) The fact that municipal digester supernatant was substituted for digested swine manure in January 1986.

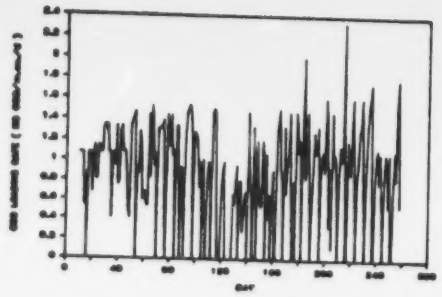
2.5.2 Method and Results

The results of the monitoring program for the full-scale digester are given in Table C-1 in Appendix C, and summarized graphically in Figure 15(a) to 15(j). In August 1985, the cheese plant began adding digested swine manure to the full-scale anaerobic digester. This was in response to the internal laboratory-scale research work by CANVIRO (1985b) that indicated that loadings up to 1.93 kg COD/m^3 digester volume were achievable daily additions of 10% digested swine manure.

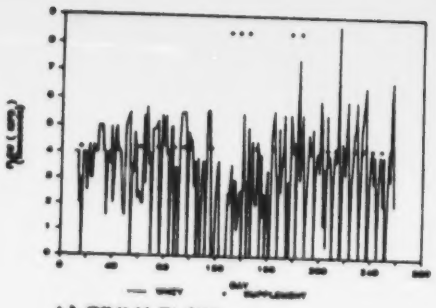
From September-December 1985, Figure 15(d) shows that the pH of the full-scale digester was kept at approximately 7.0. This was accomplished by adding digested swine manure into the digester. However, these manure additions were not 10% daily additions as was done at lab-scale. Instead, they were in 4,200 Imperial gallon (one truckload) batch additions approximately every 2 weeks as this was the most economical way of placing the digested swine manure into the digester. Consequently, these batch additions may not have been the best for obtaining optimum operation at full-scale. During this time, the loadings achieved never reached the levels obtained at lab-scale. During the period of September-December 1985, the highest digester loadings obtained were in the range of 1.1-1.2 kg COD/m^3 digester volume (as opposed to 1.93 kg COD/m^3 digester volume at laboratory-scale in CANVIRO's internal research work).

By January 1986, based on the laboratory-scale work being conducted on-site, it was believed that the addition of municipal digester supernatant was superior to that of digested swine manure. It was thus decided to terminate the digested swine manure addition and to begin weekly additions of municipal digester supernatant supplement. This began on January 23, 1986.

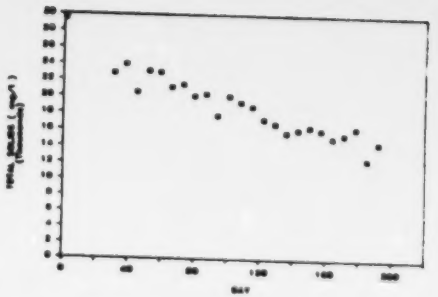
In the initial stages between January and February 1986, there was little value to the data obtained as this was the period when 2 of the 3 mixers from the full-scale digester were out for repair. Consequently, there was less whey being fed into the digester at this time. Between February and



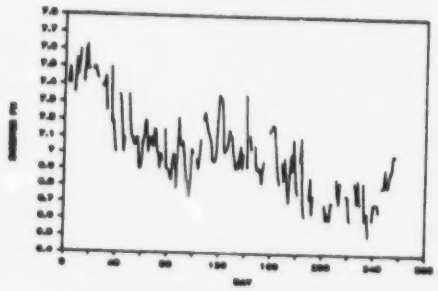
a) COD LOADING RATE



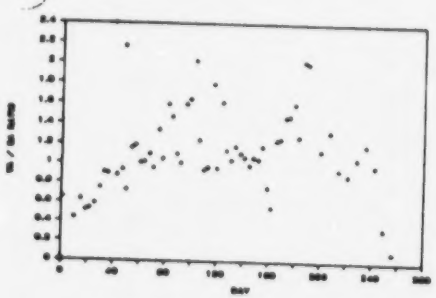
b) DAILY FLOW



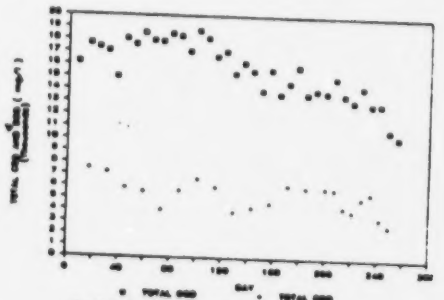
c) EFFLUENT TOTAL SOLIDS



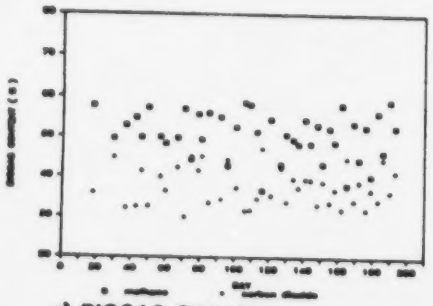
d) DAILY pH



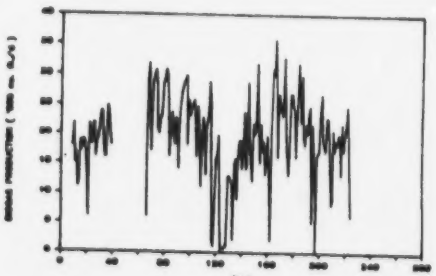
e) VA/BA RATIO



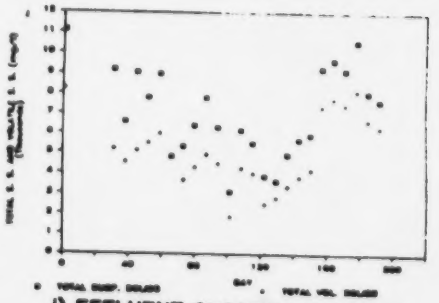
f) EFFLUENT COD & BOD



g) BIOGAS QUALITY



h) BIOGAS PRODUCTION



j) EFFLUENT SUSPENDED SOLIDS

FIGURE 15: DATA SUMMARY FOR FULL SCALE DIGESTER

May, the municipal digester supernatant was added on a once per week basis in 4,200 Imperial gallon truckloads. This initially had, seemingly very little effect on the improvement of the digester's operation as maximum average weekly digester loadings only approached 0.8 kg COD/m^3 digester volume and the VA/BA ratio ranged in the 1.0 area. However, in late May, the VA/BA ratio dropped to 0.1. At this point, the whey loadings to the digester were somewhat increased with no negative effects. By July of 1986, Figure 15(a) shows that COD loading of 1.4 kg COD/m^3 digester volume/day and greater were being attained. In July and August, the biogas generated by the digester provided sufficient fuel to keep the dual fuel boiler burning biogas almost all of the time. During some periods, the biogas production exceeded the boiler requirements and it was necessary to burn excess gas in the waste biogas flare.

2.5.3 Discussion

For the purposes of discussion, the digester operation has been divided into 3 as follows:

1. Full-Scale Digester Operation from August - December 1985
2. Full-Scale Digester Operation from January - May 1986
3. Full-Scale Digester Operation from June - August 1986

These are discussed below.

Operation from August to December, 1985

The full-scale digester was maintained at pH = 7.0 during the period between August and December 1985, using digested swine manure on an as required basis. At no time did the loadings to the full-scale digester approach those of 1.93 kg COD/m^3 volume that were achieved at laboratory-scale during CANVIRO's internal research study.

In hindsight, it seems quite possible that had the addition of the digested swine manure been on a more frequent basis such as once per week or even more often, values this high or even somewhat higher may in fact have been obtained. This is based on the results of the laboratory-scale work conducted on-site, and subsequently, at CANVIRO's laboratory with whey and 10% digested swine manure supplement addition, where although the lab-scale

reactors were quite slow in starting up when compared to those receiving municipal digester supernatant supplement, they were able to achieve loadings of 3.3 kg COD/m^3 volume with daily additions of 10% digested swine manure supplement after 8 months of operation. However, the addition of this digested swine was more costly and more odourous than that of the municipal digester supernatant.

Operation from January to May 1986

During the period from January to May 1986, the full-scale digester received one load (4,200 Imperial gallons) of municipal digester supernatant supplement per week. However, the digester was only able to achieve loadings in the range of 0.7 kg COD/m^3 digester volume/day.

Initially, these low loading rates were not of great concern as the digester's inability to achieve higher loadings was attributed to the fact that 2 of the 3 digester mixers had been removed form the digester for repair from mid-January until mid-February. However, the return of the mixers to the digesters did not appear to have any significant positive effect on the digester's operation during this period until May 22, 1986 when the VA/BA ratio dropped to 0.34 and May 29, 1986 when the VA/BA ratio again dropped to 0.10. It is believed that this period between January and May 1986 was required for start-up. This was much greater than the time required for the start-up at laboratory-scale. While it was never confirmed at laboratory-scale, this "slow" start-up is believed to have been the result of weekly supplement additions as opposed to daily supplement additions.

Operation from June to August 1986

During this period, the once per week addition of one truckload of the municipal digester supernatant supplement (i.e. 4,200 Imperial gallons) continued. The whey loadings were increased during this period to 25 m^3/day (5,500 Igpd) 5 days per week without affecting the VA/BA ratio which remained approximately equal to 0.10. The COD loadings achieved during this period were upwards of 1.4 kg COD/m^3 digester volume/day and greater. It is believed based on the lab-scale work that this loading could be increased to values approaching 2.0 kg COD/m^3 digester volume if the once per week digester supernatant addition (i.e. 15% or greater supplement addition) is continued.

There were also some operational adjustments made to the full-scale digester system during this period. One was the installation of a timing device on the whey feed pump. This allowed feeding of smaller amounts of whey throughout the day as opposed to one batch feed during the day. Another was the turning off of two of the three mixers during the night. This did not seem to have any negative effect on the overall digestion process and it allowed the biogas generated during the night to be given off in the morning when the 2 mixers were re-started. This allowed the cheese plant to better utilize the biogas as the fuel demand is greatest in the morning and early afternoon. This also reduces the overall energy requirement of the facility.

Summary of Digester Operation from September 1985 - August 1986

In summarizing the September 1985 - August 1986 full-scale digester operation, the following is worth noting:

1. Based on the lab-scale and full-scale work with both the digested swine manure supplement and the municipal digester supernatant supplement, it is believed that stable operation is obtained much more quickly with a daily supplement addition as opposed to a weekly addition.
2. Although it was never confirmed at full-scale, it is believed that for day to day operation (after start-up is achieved), the more often a supplement is added, the greater the loading that can be achieved. However, it is more advantageous to the cheese plant to have once every week supplement additions. It would be beneficial if a 'dry' substance (i.e. without the water that is the major part of the municipal digester supernatant and the digested swine manure) could be found that could act as the nutrient/buffer supplement and be added daily.

2.6 Task 5: Technical and Economic Assessment of the Optimized System

2.6.1 General

During the study, one major change in whey disposal costs occurred when a customer for the whey was located in the Fall of 1985. This customer was willing to take all or a portion of the cheese plant's whey at no cost.

As a result, the only benefit that the full-scale anaerobic digester provided to the cheese plant was that of energy production. The optimization of the full-scale anaerobic digestion system takes this factor into account.

2.6.2 Technical Aspects of the Optimized System

The results of the study to August 1986 indicated that the major technical components of the optimized system could be described as follows:

1. A 5 day per week average whey feeding of 25 cubic meters per day (5,500 Igpd) is optimum during the summer months, as it is not possible to burn any more biogas than is generated by this feedrate. During the winter months, it is anticipated that they whey feedrate production would increase to 32 m^3/day (7,000 Igpd) six days per week when more biogas fuel could be utilized.
2. A once weekly addition of 19 cubic meters (4,200 Igpd) of municipal digester supernatant is required during the 6 summer months. If the whey feedrate is increased during the 6 winter months as in 1 above, the supplement addition will be three times every 2 weeks making a total annual supplement addition of 65 truckloads.
3. The VA/BA ratio should be approximately equal to 0.10.
4. The effluent COD and BOD concentrations should be equal to 11,000 mg/L and 6,100 mg/L. This represents COD and BOD reductions of 83% to 84%.
5. Daily biogas productions during the summer (Monday-Friday) of an average of 1,000 m^3/day (35,000 ft^3/day). It is assumed that during the winter the whey feed would be increased to 32 m^3/day 6 days/week and the resultant biogas production would be 1280 m^3/day.

For the purposes of technical assessment, it is assumed that the average of 1,000 cubic meters of biogas will be utilized during the 6 summer months 5 days a week and the average of 1,280 cubic meters of biogas will be utilized 6 days a week during the winter months. This represents a gross annual biogas utilization of:

$$1{,}000\ m^3 \times 5\ d/wk \times 26\ wk/yr + 1{,}280\ m^3/d \times 6\ d/wk \times 26\ wk/yr$$
$$= 329{,}680 \text{ cubic meters/year}$$

It is estimated that this biogas generated by the anaerobic digestion system has a fuel value of 18,600 kJ per cubic meter of biogas. Therefore, the estimated annual biogas production of 329,680 cubic meters represents a potential gross annual energy recovery of 6,132 GJ.

A detailed energy balance to determine the net energy generated by the full-scale system was not part of this project as this would have required a considerable amount of instrumentation and metering on various mechanical and electrical lines. However, it is possible to provide an estimate of the net energy generated by the facility from the following:

Net Energy Generated/yr = Gross Energy Generated/yr (GJ/yr)
- Electrical Requirement/yr (GJ/yr) - Fuel Requirements for Digester Heating/yr (GJ/yr)

The annual electrical requirement (September 1985 - August 1986 Ontario Hydro Bills) is 75,000 kW/hr. This is equivalent to 270 GJ/yr.

The annual steam heating requirement for the digester and the whey is estimated at 610 GJ/yr (CANVIRO 1985a). Therefore, the annual net energy generated is estimated as:

6,132 GJ/yr	-	270 GJ/yr	-	610 GJ/yr
(Gross Energy)		(Electrical Energy Requirement)		(Steam Heating Energy Requirement)

= 5,252 GJ/yr (Net Annual Energy Generation)

2.6.3 Economic Assessment of the Optimized System

As discussed previously, the only economic benefit that the Millbank cheese plant is now realizing from the full-scale system is that of biogas utilization. For anaerobic digestion of whey to be economically viable at future installations, there would have to be some benefits associated with whey disposal as the biogas fuel benefits are not sufficient to economically justify the capital costs for a full-scale anaerobic digestion installation.

The operation and maintenance costs for the full-scale system based on the technical aspects discussed in the previous section are given in Table 8.

TABLE 8. ANNUAL OPERATION AND MAINTENANCE COSTS FOR THE FULL-SCALE ANAEROBIC DIGESTION FACILITY

DESCRIPTION	COST
Digestion Facility Maintenance Repairs, etc.	$ 5,000.00
Digestion Facility Operations	
- Steam	N/C[1]
- Hydro (Aug 1985 - Aug 1986)	4,400.00
Operator 10 hr/wk x 52 wks/yr x $13.00/hr	6,760.00
65 loads of municipal digester supernatant @ $240/load (hauling costs)	15,600.00
TOTAL ANNUAL COSTS	$ 31,760.00

1. See Discussion of Benefits below

From Table 8, the total annual cost is shown as $31,760. The $15,600 for supplement hauling costs represents approximately one-half of this. If an inexpensive "dry" supplement could be obtained to replace the municipal digester supernatant and added daily, these annual costs could be reduced substantially. In addition, the digester's operation could improve as the work at lab-scale indicated that daily supplement addition were superior to weekly additions.

The benefits from the full-scale anaerobic digestion facility accrue entirely from those of biogas utilization and resultant savings in fuel oil consumption.

From observations at the plant during the summer and from comparison of fuel bills for June-August of 1985 and 1986, the following was noted:

1. The dual fuelled 50 HP boiler operated primarily on biogas during the day during the summer of 1986, except during peak fuel demand times.
2. The No.4 fuel oil fuelled 100 HP boiler was seldom on during the day during the summer of 1986 and was used primarily for very short periods during the peak fuel demand times.
3. In 1986, the dual fuelled 50 HP boiler was operated as the prime boiler, with the 100 HP being utilized only during peak demands. This was the opposite of 1985 when the larger 100 HP boiler was the prime boiler.

Based on the above, it was concluded that approximately 2/3 of the biogas being utilized was replacing No.2 fuel oil that had been used in the 50 HP dual fuelled boiler in 1985 and approximately 1/3 of the biogas being utilized was replacing No.4 fuel oil that had been utilized in the 100 HP boiler in 1985. These utilizations were used to determine the benefits accrued from the biogas utilization as follows:

- 2/3 of the biogas utilized represents a saving in #2 fuel oil of:

  2/3 x 5,252 GJ/yr x 10^6 kJ/GJ ÷ 38,610 kJ/litre #2 fuel oil x $0.289/litre = $26,208

- 1/3 of the biogas utilized represents a saving in #4 bunker fuel of:

  1/3 x 5,252 GJ/yr x 10^6 kJ/GJ ÷ 41,657 kJ/litre #4 fuel x $0.253/litre = $10,632

The total fuel savings based on the above calculations is $36,840. The net benefit achieved by the full-scale system is estimated as $36,840 - $31,760 = $5,080.

It is again noted that the net benefit does not include for any payback on the original capital investment. There, the economics for future installations is not attractive. This will be the case until such time as either energy costs increase significantly or whey disposal again becomes a major cheese plant expense.

2.7 Task 6: Information Transfer

Tours of the full-scale facility were provided during the project by cheese plant or CANVIRO personnel on an as requested basis. The people on these tours included individuals representing industry and engineering firms, researchers and students. Although a formal list of all people visiting the facility was not kept, it is worth noting that there were individuals from Europe and the United States who visited the facility.

During the early portion of the project in November of 1985, Mr. R.J. Rush, P.Eng., of CANVIRO Consultants attended the Fourth International Symposium on Anaerobic Digestion in Guangzhou, China. At this conference, Mr. Rush was able to meet with the world's leading experts on anaerobic

digestion and discuss the progress and problems that were being experienced with the operation of the full-scale anaerobic facility at the Millbank cheese plant. It was at this conference that the other full-scale anaerobic digestion facility for whey in North Wales was identified.

More recently, CANVIRO prepared a paper [Adams and Lowe (1987)] and provided a poster for inclusion at the Sixth Annual Bioenergy R&D Seminar held in Vancouver in February, 1987. This poster is shown in Figure 16.

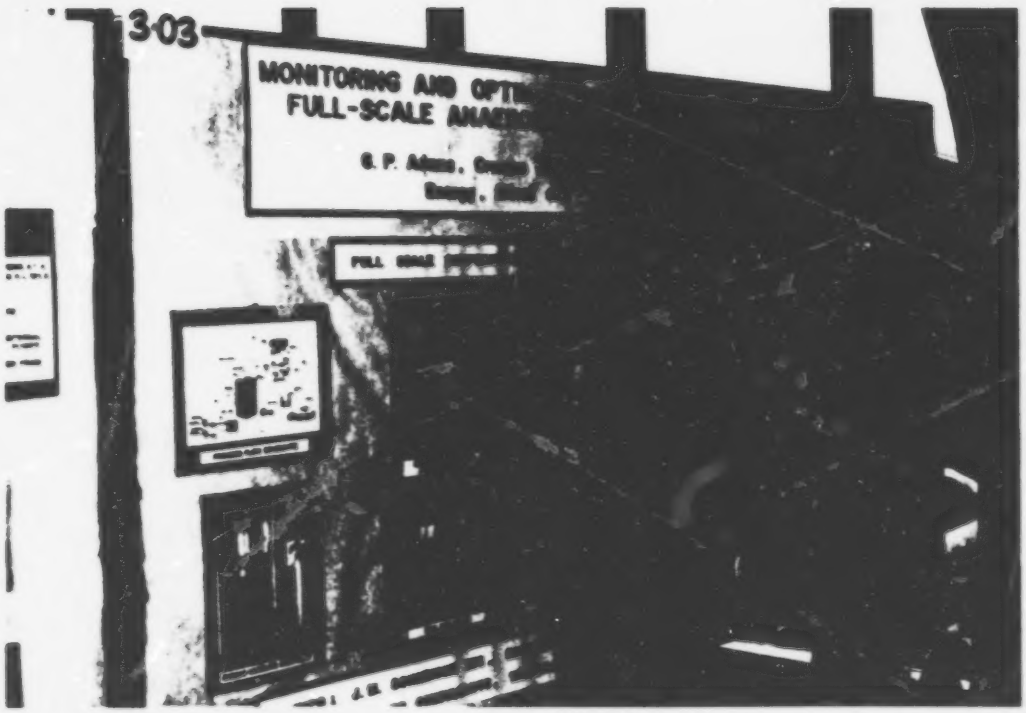


FIGURE 16: POSTER PRESENTATION AT SIXTH CANADIAN BIOENERGY R&D SEMINAR

3.0 CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusions

1. CANVIRO's internal research in 1985 and the results of the literature review indicate that a nutrient/buffer supplement addition is required if whey is to be successfully treated by anaerobic digestion.

2. Whey loading rates of 2.2 kg COD/cubic meter of digester volume per day are attainable at lab-scale with 15% daily additions of municipal digester supernatant. At full-scale, this would be equivalent to a daily whey feedrate of 36 cubic meters (8000 Imperial gallons) per day.

3. Whey loading rates of 3.3 kg COD/cubic meter of digester volume are attainable at lab-scale with 10% daily additions of digested swine manure. At full-scale, this would be equivalent to a daily whey feed rate of 54 cubic meters (12,000 Imperial gallons) per day.

4. The utilization of caustic (NaOH) for pH control was not satisfactory. It was concluded that this was due to the toxic effect the sodium may have had on the microorganisms.

5. The results obtained from the lab-scale fixed film reactor and the completely mixed lab-scale reactor operating at thermophilic (55°C) temperature for whey plus 10% digested swine manure were similar to those obtained for the completely mixed lab-scale reactor at mesophilic temperatures. This indicated that for whey digestion, fixed film and thermophilic operation would not provide any benefits.

6. Based on the additional lab-scale study that was conducted from April to June 1986, it was concluded that daily additions of either digested swine manure or municipal digester supernatant were more effective than weekly additions.

7. The full-scale reactor was much slower to start up and achieve stable operation. One of the major reasons believed to be responsible for this was that the supplement was not added daily as was done at lab-scale.

8. The full-scale loadings achieved by the end of August 1986 were not as high as those achieved at lab-scale. However, the 5 day/week whey feedrates of 25-27 cubic meters (5500-6000 Imperial gallons) per day were sufficiently high to provide the dual fuelled boiler with as much biogas as it could utilize during the summer months. It was anticipated that the whey feedrate would increase during the cooler fall and winter months when the heating requirements increase.

9. An average whey feed rate of 25-27 cubic meters 5 days per week during the summer and an average feedrate of 32 cubic meters 6 days per week during the winter would result in a gross annual energy production of 6,132 GJ.

10. A more detailed energy balance than that shown within the study was not conducted as it was not possible to monitor all energy utilization and it was not necessary for the facility's optimization. From the information available, the facility has an estimated net energy generation of 5,252 GJ/yr.

11. The annual net profit from the optimized full-scale anaerobic digestion facility is estimated as $5,080.00. This does not provide any allowance for capital cost amortization. For a full-scale system such as this to have a cost-effectiveness, there must either be an increase in energy costs or there must be other benefits other than those from biogas utilization. This would include those for whey disposal or for whey treatment. It was also concluded that the net profit from the full-scale facility could be increased if the costs for supplement addition could be reduced.

3.2 Recommendations

1. Unless the digestion of whey powder become viable, it is recommended that any future study or research work on the anaerobic digestion of whey be conducted on raw whey. This is recommended as much of the previous work with whey powder dealt with an influent having a significantly lower COD content than raw whey. This factor serves to make scale-up decisions more difficult.

2. Some further attempt should be made to identify if an economical 'dry' supplement that can be added daily can be identified. Therefore, further contact should be made with the owners/operators of the other full-scale anaerobic digestion facility on whey in Pwllheli, North Wales to determine the contents of their supplement additive.

3. It is recommended that for start up of an anaerobic digestion facility on whey that seed material such as digested manure or municipal digester sludge be obtained. In this study, it was found that the required bacterial population was slow to develop using municipal digester supernatant as the seed material.

4. During future startups, it is also recommended that, if possible, the supplement be added daily as it was believed that the weekly additions retarded the start-up at full-scale.

5. It is recommended for future installations that a specific biogas production rate of 0.6-0.7 cubic meters/kg COD utilized be used in future installations. This is somewhat higher than that of 0.41 which was originally used for the Millbank facility.

6. For future installations, if supplements other than municipal digester supernatant or digested swine manure are to be used, it is recommended that lab-scale work be conducted to establish design criteria.

7. It is recommended that any subsequent work to this study might involve a detailed analysis and comparison of the components of the municipal digester supernatant, the digested swine manure and the supplement (if its contents can be obtained) being used in North Wales to determine if there are any elements that may be responsible for enhancing the digestion process. This would be valuable not only for whey digestion, but also for many other high strength wastes.

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APPENDIX A

COPY OF UNIVERSITY OF WATERLOO
COMPUTER SEARCH FOR
LITERATURE REVIEW

APPENDIX A: COPY OF UNIVERSITY OF WATERLOO COMPUTER SEARCH FOR LITERATURE REVIEW

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 ********
0020800  INVALID ACCOUNT NUMBER
DIALOG INFORMATION SERVICES
PLEASE LOGON:
?*********
 ********
ENTER PASSWORD:
?*********
 ********

Welcome to DIALOG
Dialog version 2, level 11.8.12 A

Last logoff  23dec86 15:20:36
Logon file001 24dec86 09:07:09
** MAP IS NOT WORKING **
COPR. (c) DIALOG INFORMATION SERVICES399

        24dec86 09:07:15 User002080
     $0.09    0.003 Hrs File1
     $0.03  Tymnet
     $0.12  Estimated cost this file
     $0.12  Estimated total session cost   0.002 Hrs.

File 399:CA SEARCH 1967-1986 UD=10524
(Copr. 1986 by the Amer. Chem. Soc.)

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            3473  WHEY  (SEE ?IGNOTE)
            5205  DAIRY
      S2      93  (S1 AND (WHEY OR DAIRY))
?t 2/6/1-5

 2/6/1
   105213656    CA: 105(24)213656s    JOURNAL
   Anaerobic digestion of high-strength cheese whey utilizing semicontinuou
digesters and chemical flocculant addition
   JOURNAL: Biotechnol. Bioeng.  DATE: 1986  VOLUME: 28  NUMBER: 11
   PAGES: 1601-7

 2/6/2
   105196605    CA: 105(22)196605e    JOURNAL
   Innovative biological systems for anaerobic treatment of grain and food
processing wastewaters
   JOURNAL: Starch/Staerke  DATE: 1986  VOLUME: 38  NUMBER: 9  PAGES: 314-1

 2/6/3
   105120066    CA: 105(14)120066J    JOURNAL
   Effect of different neutralizing treatments on the efficiency of an
anaerobic digester fed with deproteinated cheese whey
   JOURNAL: J. Dairy Res.  DATE: 1986  VOLUME: 53  NUMBER: 3  PAGES: 467-7

 2/6/4
   105118053    CA: 105(14)118053J    CONFERENCE PROCEEDING
   An improved plug-flow design for the anaerobic digestion of dairy cattle
waste
   JOURNAL: Biogas Technol., Transfer Diffus., (Proc. Int. Conf.)
   EDITOR: El-Halwagi, M. M (Ed)^  DATE: 1986  PAGES: 259-69

 2/6/5
   105100371    CA: 105(12)100371b    JOURNAL
   Operation of a bench scale anaerobic digester for the production of
methane gas from cheese whey
   JOURNAL: Rev. Microbiol.  DATE: 1986  VOLUME: 17  NUMBER: 2
   PAGES: 155-61
?t 2/8/1-5

 2/8/1
   Anaerobic digestion of high-strength cheese whey utilizing semicontinuou
digesters and chemical flocculant addition
   SECTION:
CA160001 Waste Treatment and Disposal
CA117XXX Food and Feed Chemistry
   IDENTIFIERS: cheese whey anaerobic digestion flocculation, whey anaerobi
semicontinuous digestion flocculation
   DESCRIPTORS:
Wastewater treatment,flocculation...
     in cheese whey anaerobic semicontinuous digestion
Wastewater treatment,digestion, anaerobic...
     of cheese whey, in semicontinuous app., flocculation in,
Whey...
     wastewater contg., treatment of, by anaerobic semicontinuous digestion,
     flocculation in
Cheese...
     wastewater from manuf. of, treatment of, by anaerobic semicontinuous
     digestion, flocculation in

 2/8/2
   Innovative biological systems for anaerobic treatment of grain and food
processing wastewaters
   SECTION:
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CA160001 Waste Treatment and Disposal
CA117XXX Food and Feed Chemistry
IDENTIFIERS: food processing wastewater anaerobic treatment, whey processing wastewater anaerobic treatment, flour processing wastewater anaerobic treatment
DESCRIPTORS:
Wastewater treatment,anaerobic, fluidized-bed...
fixed-film, of grain and food processing effluents
Wastewater treatment,biol....
in suspended growth membrane system, of food and grain processing effluents
Food...Soybean,whey... Wheat flour...Whey...
wastewater from processing of, treatment of, by fluidized-bed fixed film and suspended growth membrane systems

2/8/3
Effect of different neutralizing treatments on the efficiency of an anaerobic digester fed with deproteinated cheese whey
SECTION:
CA160001 Waste Treatment and Disposal
CA117XXX Food and Feed Chemistry
CA152XXX Electrochemical, Radiational, and Thermal Energy Technology
IDENTIFIERS: pH control anaerobic digestion whey, neutralization anaerobic digestion whey stability
DESCRIPTORS:
Whey...
deproteinated, anaerobic digestion of, pH control in, agents for, process stability and efficiency in relation to
Wastewater treatment,digestion, anaerobic...
of deproteinated cheese whey, pH control in, agents for, process stability and efficiency in relation to
CAS REGISTRY NUMBERS:
74-82-8P preparation, formation of, in anaerobic digestion of deproteinated cheese whey, pH control agent effect on
7440-44-0 uses and miscellaneous, conversion of, to biogas, in anaerobic digestion of deproteinated cheese whey, pH control agent effect on
7727-37-9 14798-03-9 uses and miscellaneous, in anaerobic digestion effluents, pH control agent effect on, in deproteinated cheese whey treatment
57-13-6 497-19-8 1310-73-2 uses and miscellaneous, pH control by, in anaerobic digestion of deproteinated cheese whey, process stability and efficiency in relation to

2/8/4
An improved plug-flow design for the anaerobic digestion of dairy cattle waste
SECTION:
CA152001 Electrochemical, Radiational, and Thermal Energy Technology
CA145XXX Industrial Organic Chemicals, Leather, Fats, and Waxes
CA160XXX Waste Treatment and Disposal
IDENTIFIERS: biogas manure feran digester design, digester plug flow biogas manuf, methane manuf plug flow digester
DESCRIPTORS:
Manure...
biogas manuf. from, by feran., with plug-flow digester
Fuel gas manufacturing,biogas...
from manure, by feran., with plug-flow digester
Fermentation apparatus...
plug-flow, for biogas manuf., from manure
CAS REGISTRY NUMBERS:
64-19-7P preparation, formation of, in biogas manuf., from manure, by feran.
74-82-8P preparation, manuf. of gas contg., from manure, by feran., with plug-flow digester

2/8/5

operation of a pilot scale anaerobic digester for the production of methane gas from cheese whey

SECTION:
CA152001 Electrochemical, Radiational, and Thermal Energy Technology
CA145XXX Industrial Organic Chemicals, Leather, Fats, and Waxes
CA160XXX Waste Treatment and Disposal
IDENTIFIERS: biogas feram cheese whey, sodium hydroxide feram cheese whey
DESCRIPTORS:
Waste solids;whey... Whey...
biogas manuf. from, by feram.
Fuel gas manufacturing;biogas...
from cheese whey, by feram.
CAS REGISTRY NUMBERS:
74-82-8P preparation, manuf. of gas contg., from cheese whey, by feram.

?s s1 and (whey or dairy)/de,id

	8004	S1	
	3389	WHEY/DE,ID	(SEE TIGNOTE)
	3267	DAIRY/DE,ID	
S3	88	S1 AND (WHEY,OR DAIRY)/DE,ID	

?t38/ens

S4 80 3/ENG

?t 4/3/1-25

4/3/1
105213656 CA: 105(24)213656s JOURNAL
Anaerobic digestion of high-strength cheese whey utilizing semicontinuous digesters and chemical flocculant addition
AUTHOR(S): Barford, J. P.; Cail, R. B.; Callander, I. J.; Floyd, E. J.
LOCATION: Dep. Chem. Eng., Univ. Sydney, Australia
JOURNAL: Biotechnol. Bioeng. DATE: 1986 VOLUME: 28 NUMBER: 11
PAGES: 1601-7 CODEN: BIBIAU ISSN: 0006-3592 LANGUAGE: English

4/3/2
105196605 CA: 105(22)196605e JOURNAL
Innovative biological system for anaerobic treatment of grain and food processing wastewaters
AUTHOR(S): Sutton, Paul M.
LOCATION: Gen. Manager Biol. Syst., Door-Oliver Inc., Stamford, CT, 0690, USA
JOURNAL: Starch/Staerke DATE: 1986 VOLUME: 38 NUMBER: 9 PAGES: 314-1
CODEN: STARDD ISSN: 0038-9056 LANGUAGE: English

4/3/3
105120066 CA: 105(14)120066J JOURNAL
Effect of different neutralizing treatments on the efficiency of an anaerobic digester fed with deproteinated cheese whey
AUTHOR(S): De Haast, Johannes; Britz, Trevor J.; Novello, Johannes C.
LOCATION: Dep. Dairy Sci., Univ. Orange Free State, Bloemfontein, 9300, Afr.
JOURNAL: J. Dairy Res. DATE: 1986 VOLUME: 53 NUMBER: 3 PAGES: 467-76
CODEN: JDRSAN ISSN: 0022-0299 LANGUAGE: English

4/3/4
105065746 CA: 105(8)65746d JOURNAL
Influence of temperature on the performance of anaerobic fixed-film reactors utilizing screened dairy manure
AUTHOR(S): Lo, K. V.; Chen, W. Y.; Liao, P. H.
LOCATION: Dep. Bio-Resour. Eng., Univ. British Columbia, Vancouver, BC, Can., V6T 1W5
JOURNAL: Biomass DATE: 1986 VOLUME: 9 NUMBER: 3 PAGES: 173-85
CODEN: BIOME9 ISSN: 0144-4565 LANGUAGE: English

4/3/5
105048341 CA: 105(6)48341a JOURNAL
New technology in dairy wastewater treatment
AUTHOR(S): De Man, B.; De Bekker, P. H. A. M. J.
LOCATION: Environ. Eng. Dep., Grontaij N. V., 3730 AE, De Bilt, Neth.
JOURNAL: Dairy Ind. Int. DATE: 1986 VOLUME: 51 NUMBER: 5
PAGES: 21, 23-5 CODEN: DINIDD ISSN: 0308-8197 LANGUAGE: English

4/3/6
105048336 CA: 105(6)48336c JOURNAL
Stability of a percolating anaerobic downflow fixed film reactor under overloading conditions
AUTHOR(S): Canovas-Diaz, M.; Howell, J. A.
LOCATION: Dep. Chem. Eng., Univ. Coll. Swansea, Swansea, UK, SA2 8PP
JOURNAL: Biotechnol. Lett. DATE: 1986 VOLUME: 8 NUMBER: 5
PAGES: 379-84 CODEN: BILED3 ISSN: 0141-5492 LANGUAGE: English

4/3/7
105027083 CA: 105(4)27083c JOURNAL
Mesophilic digestion of screened dairy manure using anaerobic rotating biological contact reactor
AUTHOR(S): Lo, K. V.; Chen, W. Y.; Liao, P. H.
LOCATION: Dep. Bio-Resourc. Eng., Univ. British Columbia, Vancouver, BC, Can., V6T 1W5
JOURNAL: Biomass DATE: 1986 VOLUME: 9 NUMBER: 2 PAGES: 81-92
CODEN: BIOME9 ISSN: 0144-4565 LANGUAGE: English

4/3/8
105027078 CA: 105(4)27078e CONFERENCE PROCEEDING
Online monitoring and control of an anaerobic methane digestion process with the aid of a mathematical model
AUTHOR(S): Maerkl, H.; Mather, M.; Wittv, W.
LOCATION: Tech. Univ. Muenchen, 8000/2, Munich, Fed. Rep. Ger.
JOURNAL: Eur. Constr. Biotechnol., 3rd DATE: 1984 VOLUME: 3,
PAGES: 137-44 CODEN: 55BBA6 LANGUAGE: English PUBLISHER: Verlag Chemie, Weinheim, Fed. Rep. Ger

4/3/9
105011361 CA: 105(2)11361f JOURNAL
The treatment of dairy wastewater by the anaerobic up-flow packed bed reactor
AUTHOR(S): Backman, Robert C.; Blanc, Frederic C.; O'Shaughnessy, James C.
LOCATION: Dep. Civ. Eng., Northeast. Univ., Boston, MA, 02115, USA
JOURNAL: Proc. Ind. Waste Conf. DATE: 1985 VOLUME: 40th, PAGES: 361-7
CODEN: PIWCAX ISSN: 0073-7682 LANGUAGE: English

4/3/10
104212530 CA: 104(24)212530p JOURNAL
Scale-up of the membrane anaerobic reactor system
AUTHOR(S): Li, Alan Y.; Corrado, J. J.
LOCATION: Dorr-Oliver Inc., Stamford, CT, 06904, USA
JOURNAL: Proc. Ind. Waste Conf. DATE: 1985 VOLUME: 40th,
PAGES: 399-404 CODEN: PIWCAX ISSN: 0073-7682 LANGUAGE: English

4/3/11
104212504 CA: 104(24)212504h JOURNAL
Anaerobic treatment of dairy wastewater
AUTHOR(S): Nieuwenhof, F. F. J.
LOCATION: Netherlands Inst. Dairy Res., Ede, Neth.
JOURNAL: Bull. Int. Dairy Fed. DATE: 1984 VOLUME: 184
NUMBER: Dairy Effluents PAGES: 132-4 CODEN: BIDFDY ISSN: 0250-5118
LANGUAGE: English

4/3/12
104212472 CA: 104(24)212472w JOURNAL

Anaerobic digestion
AUTHOR(S): Ryder, D. N.
LOCATION: Dairy Creat Res. and Dev. Div., UK
JOURNAL: Bull. Int. Dairy Fed. DATE: 1984 VOLUME: 184
NUMBER: Dairy Effluents PAGES: 127-31 CODEN: BIDFDY ISSN: 0250-5118
LANGUAGE: English

4/3/13
104192313 CA: 104(22)192313a CONFERENCE PROCEEDING
Application of the unique Biomass International Anaerobic Packed Bed Reactor to waste water from the food and drink industry
AUTHOR(S): Anderson, G. K.; McKeown, K. J.; Turner, I. M.
LOCATION: Dep. Civil Eng., Univ. Newcastle-Upon-Tyne, Newcastle-Upon-Tyne, UK
JOURNAL: Proc. - Int. Conf. Fixed-Film Biol. Processes, 2nd EDITOR: Bani w, John T (Ed) DATE: 1985 VOLUME: 2, PAGES: 1718-40 CODEN: 54YXAA
LANGUAGE: English MEETING DATE: 840000 PUBLISHER: US Army Corps Eng. Constr. Eng. Res. Lab., Champaign, Ill

4/3/14
104173767 CA: 104(20)173767z TECHNICAL REPORT
Anaerobic stabilization of agricultural and food-based industrial wastes
AUTHOR(S): Winter, J.; Wildenauer, F. X.
LOCATION: Dep. Microbiol., Univ. Regensburg, D-8400, Regensburg, Fed. Rep. Ger.
JOURNAL: Comm. Eur. Communities, (Rep.) EUR DATE: 1985
NUMBER: EUR 10024, Energy Biomass PAGES: 469-73 CODEN: CECED9
LANGUAGE: English

4/3/15
104115408 CA: 104(14)115408x CONFERENCE PROCEEDING
High rate anaerobic digestion of industrial wastes
AUTHOR(S): Cail, R. G.; Barford, J. P.; Prince, R. G. H.
LOCATION: Dep. Chem. Eng., Univ. Sydney, Sydney, Australia
JOURNAL: Winning Coapet. World, Aust. Chem. Eng. Conf., 12th DATE: 1984 VOLUME: 1, PAGES: 225-32 CODEN: 54VWAQ LANGUAGE: English
PUBLISHER: Inst. Eng. Aust., St. Leonards, Australia

4/3/16
104055626 CA: 104(8)55626e CONFERENCE PROCEEDING
The innovative TAMAN process for the pulp and paper and the food industries
AUTHOR(S): Rekunen, S.
LOCATION: Tampella Ltd., 33101, Tampere, Italy
JOURNAL: Conf. Environ., (Actes) DATE: 1985 PAGES: 25-9 CODEN: 54PEAD
LANGUAGE: English PUBLISHER: Can. Pulp Paper Assoc., Tech. Sect., Montreal, Que

4/3/17
104036895 CA: 104(6)36895e JOURNAL
Two-phase thermophilic anaerobic digestion of screened dairy manure
AUTHOR(S): Liao, P. H.; Lo, K. V.
LOCATION: Bio-Resour. Eng. Dep., Univ. British Columbia, Vancouver, BC, Can., V6T 1W5
JOURNAL: Biomass DATE: 1985 VOLUME: 8 NUMBER: 3 PAGES: 185-94
CODEN: BIOME9 ISSN: 0144-4565 LANGUAGE: English

4/3/18
104036880 CA: 104(6)36880s JOURNAL
Two-phase anaerobic digestion of screened dairy manure
AUTHOR(S): Lo, K. V.; Liao, P. H.
LOCATION: Bio-Resour. Eng. Dep., Univ. British Columbia, Vancouver, BC, Can., V6T 1W5
JOURNAL: Biomass DATE: 1985 VOLUME: 8 NUMBER: 2 PAGES: 81-90
CODEN: BIOME9 ISSN: 0144-4565 LANGUAGE: English

4/3/19
104036878 CA: 104(6)36878x JOURNAL
Startup characteristics of anaerobic fixed bed reactors
AUTHOR(S): Nordstedt, R. A.; Thomas, M. V.
LOCATION: Inst. Food Agric. Sci., Univ. Florida, Gainsville, FL, USA
JOURNAL: Trans. ASAE DATE: 1985 VOLUME: 28 NUMBER: 4 PAGES: 1242-7
CODEN: TAAEAJ ISSN: 0001-2351 LANGUAGE: English

4/3/20
104023704 CA: 104(4)23704n JOURNAL
Anaerobic digestion of high-strength acidic whey in a pH-controlled up-flow fixed film loop reactor
AUTHOR(S): Wildenauer, F. X.; Winter, J.
LOCATION: Der. Microbiol., Univ. Regensburg, D-8400, Regensburg, Fed. Rep. Ger.
JOURNAL: Appl. Microbiol. Biotechnol. DATE: 1985 VOLUME: 22 NUMBER: 5 PAGES: 367-72 CODEN: AMBIDG LANGUAGE: English

4/3/21
103126449 CA: 103(16)126449s JOURNAL
Performance of a completely filled vertical through-flow anaerobic digester
AUTHOR(S): Baader, W.
LOCATION: Inst. Technol., Fed. Res. Cent. Agric., Braunschweig, Fed. Rep. Ger.
JOURNAL: FFTC Book Ser. DATE: 1985 VOLUME: 28 NUMBER: Altern. Sources Energy Agric. PAGES: 51-65 CODEN: FBSEDX ISSN: 0253-9616
LANGUAGE: English

4/3/22
103109441 CA: 103(14)109441r JOURNAL
Anaerobic digestion of deproteinated cheese whey
AUTHOR(S): De Haast, Johannes; Britz, Trevor J.; Novello, Johannes C.; Viruew, Emilise W.
LOCATION: Der. Dairy Sci., Univ. Orange Free State, Bloemfontein, 9300, S. Afr.
JOURNAL: J. Dairy Res. DATE: 1985 VOLUME: 52 NUMBER: 3 PAGES: 457-67
CODEN: JDRSAN ISSN: 0022-0299 LANGUAGE: English

4/3/23
103107565 CA: 103(14)107565k JOURNAL
Mesophilic anaerobic digestion of screened dairy manure using fixed-film reactors
AUTHOR(S): Lo, K. V.; Liao, P. H.; Bulley, N. R.
LOCATION: Der. Bio-Resouce Eng., Univ. British Columbia, Vancouver, BC, Can., V6T 1W5
JOURNAL: Energy Biomass Wastes DATE: 1984 VOLUME: 8, PAGES: 873-901
CODEN: EBWADU ISSN: 0277-7851 LANGUAGE: English

4/3/24
103008874 CA: 103(2)8874d JOURNAL
Thermophilic anaerobic digestion of screened dairy manure
AUTHOR(S): Lo, K. V.; Liao, P. H.; March, A. C.
LOCATION: Bio-Resour. Eng. Der., Univ. British Columbia, Vancouver, BC, Can., V6T 1W5
JOURNAL: Biomass DATE: 1985 VOLUME: 6 NUMBER: 4 PAGES: 301-15
CODEN: BIOME9 ISSN: 0144-4565 LANGUAGE: English

4/3/25
102225410 CA: 102(26)225410h JOURNAL
Dairy wastewater treatment by anaerobic packed bed upflow filter
AUTHOR(S): Taori, K. B.; Dhabadgaonkar, S. M.; Rasan, V.
LOCATION: Makers Dev. Serv. Pvt. Ltd., Bombay, 440021, India
JOURNAL: Tech. Annu. - Indian Assoc. Water Pollut. Control DATE: 1983 VOLUME: 10, PAGES: 21-9 CODEN: TAICDH ISSN: 0253-6714
LANGUAGE: English

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:Keep 4/1-25

      S0      25  4/1-25
?(s s4 not (manure or s0)

>>>Unrecognizable Command
?s s4 not (manure or s0)

            S0  S4
          4873  MANURE
            25  S0
    S5      40  S4 NOT (MANURE OR S0)
?s s5 not dairy()cattle

            40  S5
          5205  DAIRY
         25680  CATTLE  (SEE ?IGNOTE)
           796  DAIRY(W)CATTLE
    S6      38  S5 NOT DAIRY()CATTLE
?t 6/3/1-15

 6/3/1
   102225394    CA: 102(24)225394f    JOURNAL
   Application of membrane anaerobic reactor system for the treatment of
industrial wastewaters
   AUTHOR(S): Li, A.; Kothari, D.; Corrado, J. J.
   LOCATION: Dorr-Oliver, Inc., Stamford, CT, 06904, USA
   JOURNAL: Proc. Ind. Waste Conf.  DATE: 1985  VOLUME: 39th,  PAGES: 627-3
   CODEN: PIWCAX  ISSN: 0073-7682  LANGUAGE: English

 6/3/2
   102225387    CA: 102(26)225387f    JOURNAL
   Dairy waste treatment using industrial-scale fixed-film and upflow sludge
bed anaerobic digesters: design and start-up experience
   AUTHOR(S): Samson, ReJean; Van den Berg, Bart; Peters, Roeland; Hade,
Claude
   LOCATION: Div. Biol. Sci., Natl. Res. Counc. Canada, Ottawa, ON, Can., K1
A 0R6
   JOURNAL: Proc. Ind. Waste Conf.  DATE: 1985  VOLUME: 39th,  PAGES: 235-4
   CODEN: PIWCAX  ISSN: 0073-7682  LANGUAGE: English

 6/3/3
   102208713    CA: 102(24)208713s    JOURNAL
   Anaerobic treatment of dairy wastes using fixed-film and without-media
reactors
   AUTHOR(S): Choi, Euiso; Burkhead, Carl E.
   LOCATION: Civ. Eng. Dep., Korea Univ., Seoul, 132, S. Korea
   JOURNAL: Proc. Ind. Waste Conf.  DATE: 1985  VOLUME: 39th,  PAGES: 223-3
   CODEN: PIWCAX  ISSN: 0073-7682  LANGUAGE: English

 6/3/4
   102137155    CA: 102(16)137155w    JOURNAL
   Treatment of dairy industry wastewater with an anaerobic filter
   AUTHOR(S): Cordoba, P. R.; Sanchez Riera, F.; Sineriz, F.
   LOCATION: PROIMI, 4000, S.M. Tucuman, Argent.
   JOURNAL: Biotechnol. Lett.  DATE: 1984  VOLUME: 6  NUMBER: 11
   PAGES: 753-8  CODEN: BILED3  ISSN: 0141-5492  LANGUAGE: English

 6/3/5
   101078235    CA: 101(10)78235d    JOURNAL
   Anaerobic treatment: temperature and nutrient effects
   AUTHOR(S): Kelly, C. Richard; Switzenbaum, Michael S.
   LOCATION: Dep. Civ. Eng., Univ. Massachusetts, Amherst, MA, 01003, USA
   JOURNAL: Agric. Wastes  DATE: 1984  VOLUME: 10  NUMBER: 2  PAGES: 135-54.
   CODEN: AGWADL  LANGUAGE: English
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6/3/6
100173065 CA: 100(21)173065a JOURNAL
An investigation of the use of fluorescence to monitor activity in anaerobic treatment systems
AUTHOR(S): Pause, S. M.; Switzenbaum, M. S.
LOCATION: Dep. Civ. Eng., Univ. Massachusetts, Amherst, MA, 01003, USA
JOURNAL: Biotechnol. Lett. DATE: 1984 VOLUME: 6 NUMBER: 2
PAGES: 77-80 CODEN: BILED3 ISSN: 0141-5492 LANGUAGE: English

6/3/7
100108565 CA: 100(14)108565k JOURNAL
Anaerobic digestion of cheese whey using a stationary fixed-bed reactor
AUTHOR(S): De Haast, J.; Britz, T. J.; Novello, J. C.; Lategan, P. M.
LOCATION: Dep. Dairy Sci., Univ. Orange Free State, Bloemfontein, 9300, S. Afr.
JOURNAL: N. Z. J. Dairy Sci. Technol. DATE: 1983 VOLUME: 18 NUMBER: 3
PAGES: 261-71 CODEN: NZJDAY ISSN: 0028-8268 LANGUAGE: English

6/3/8
100071176 CA: 100(10)71176f TECHNICAL REPORT
The application of the anaerobic filter to biogas production from agricultural waste
AUTHOR(S): Colleran, E.
LOCATION: Dep. Microbiol., Univ. Coll. Galway, Galway, Ire.,
JOURNAL: Comm. Eur. Communities, (Rep.) EUR DATE: 1983 NUMBER: EUR 7563 PAGES: 58 pp. CODEN: CECED9 LANGUAGE: English

6/3/9
100012086 CA: 100(2)12086d JOURNAL
Dairy waste treatment with anaerobic stationary fixed film reactors
AUTHOR(S): Van den Berg, L.; Kennedy, K. J.
LOCATION: Div. Biol. Sci., Natl. Res. Counc. Canada, Ottawa, ON, Can., K1A 0R6
JOURNAL: Water Sci. Technol. DATE: 1983 VOLUME: 15 NUMBER: 8-9
PAGES: 359-68 CODEN: WSTED4 ISSN: 0273-1223 LANGUAGE: English

6/3/10
100012085 CA: 100(2)12085c JOURNAL
Single phase and two phase anaerobic stabilization in fluidized bed reactors
AUTHOR(S): Sutton, P. M.; Li, A.
LOCATION: Dorr-Oliver, Stamford, CT, USA
JOURNAL: Water Sci. Technol. DATE: 1983 VOLUME: 15 NUMBER: 8-9
PAGES: 333-44 CODEN: WSTED4 ISSN: 0273-1223 LANGUAGE: English

6/3/11
100012075 CA: 100(2)12075z JOURNAL
Industrial wastewater treatment using anaerobic fluidized bed reactors
AUTHOR(S): Jeris, John S.
LOCATION: Ecolotrol Inc., Bethpage, NY, 11714, USA
JOURNAL: Water Sci. Technol. DATE: 1983 VOLUME: 15 NUMBER: 8-9
PAGES: 169-76 CODEN: WSTED4 ISSN: 0273-1223 LANGUAGE: English

6/3/12
100009922 CA: 100(2)9922t CONFERENCE PROCEEDING
Anaerobic fluidized-bed treatment of whey: effect of organic loading rate, temperature and substrate concentration
AUTHOR(S): Hickey, Robert F.
LOCATION: Ecolotrol Inc., Bethpage, NY, USA
JOURNAL: Proc. - Int. Conf. Fixed-Film Biol. Processes, 1st EDITOR: Wu Yung Chih (Ed), DATE: 1982 VOLUME: 3, PAGES: 1456-75 CODEN: 50HWAN
LANGUAGE: English PUBLISHER: NTIS, Springfield, Va

6/3/13
99217928 CA: 99(26)217928n CONFERENCE PROCEEDING

Energy recovery from pretreatment of industrial wastes in the anaerobic fluidized bed process
AUTHOR(S): Li, Alan; Sutton, Paul M.; Corrado, Joseph J.
LOCATION: Dorr-Oliver Inc., Stamford, CT, USA
JOURNAL: Proc. - Int. Conf. Fixed-Film Biol. Processes, 1st EDITOR: Wu, Yung Chih (Ed). DATE: 1982 VOLUME: 3, PAGES: 1521-41 CODEN: 50MWAN
LANGUAGE: English PUBLISHER: NTIS, Springfield, Va

6/3/14
99180960 CA: 99(22)180960r JOURNAL
Response of the anaerobic fluidized bed reactor to transient changes in process parameters
AUTHOR(S): Bull, M. A.; Sterritt, R. M.; Lester, J. N.
LOCATION: Dep. Civ. Eng., Imperial Coll., London, UK, SW7 2BU
JOURNAL: Water Res. DATE: 1983 VOLUME: 17 NUMBER: 11 PAGES: 1563-8
CODEN: WATRAG ISSN: 0043-1354 LANGUAGE: English

6/3/15
99093144 CA: 99(12)93144s TECHNICAL REPORT
Treatment of cheese-whey and soft-drink-bottling wastes in an anaerobic biological fluidized-bed reactor
CORPORATE AUTHOR(S): Ecolotrol, Inc.
LOCATION: Bethpage, NY, USA
JOURNAL: Report DATE: 1982 NUMBER: NYSERDA-82-22 PAGES: 112 pp.
CODEN: D3REP3 LANGUAGE: English CITATION: Energy Res. Abstr. 1983, 8(11), Abstr. No. 26584 AVAIL: N.Y. State Energy Res. Dev. Auth., Two Rockefeller Plaza, Albany, NY 12223
?t 6/3/16-40

6/3/16
99093123 CA: 99(12)93123z JOURNAL
The effect of organic loading on the performance of anaerobic fluidized beds treating high-strength wastewaters
AUTHOR(S): Bull, M. A.; Sterritt, R. M.; Lester, J. N.
LOCATION: Public Health Eng. Lab., Imp. Coll., London, UK.
JOURNAL: Trans. Inst. Chem. Eng. DATE: 1982 VOLUME: 60 NUMBER: 6
PAGES: 373-6 CODEN: TICEAH ISSN: 0371-7496 LANGUAGE: English

6/3/17
98184929 CA: 98(22)184929n JOURNAL
Cheese whey anaerobic digestion - effect of chemical flocculant addition
AUTHOR(S): Callander, I. J.; Barford, J. P.
LOCATION: Dep. Chem. Eng., Univ. Sydney, Sydney, 2006, Australia
JOURNAL: Biotechnol. Lett. DATE: 1983 VOLUME: 5 NUMBER: 3
PAGES: 153-8 CODEN: BILED3 ISSN: 0141-5492 LANGUAGE: English

6/3/18
98149057 CA: 98(18)149057e JOURNAL
Anaerobic fluidized bed whey treatment
AUTHOR(S): Boening, Paul H.; Larsen, Vader F.
LOCATION: Dep. Civ. Eng., State Univ. New York, Buffalo, NY, 14260, USA
JOURNAL: Proc. Ind. Waste Conf. DATE: 1983 VOLUME: 37, PAGES: 293-304
CODEN: PIWCAX ISSN: 0073-7682 LANGUAGE: English

6/3/19
98144489 CA: 98(18)144489a JOURNAL
Dorr-Oliver's fixed-film, suspended-growth anaerobic system for industrial wastewater treatment and energy recovery
AUTHOR(S): Sutton, P. M.; Li, A.; Evans, R. R.; Korchin, S. R.
LOCATION: Dorr-Oliver, Inc., Stamford, CT, 06904, USA
JOURNAL: Proc. Ind. Waste Conf. DATE: 1983 VOLUME: 37, PAGES: 667-75
CODEN: PIWCAX ISSN: 0073-7682 LANGUAGE: English

6/3/20
98077597 CA: 98(10)77597f JOURNAL

Simplified monod kinetics of methane fermentation of animal wastes
AUTHOR(S): Hill, D. T.
LOCATION: Dep. Agric. Eng., Auburn Univ., Auburn, AL, 36849, USA
JOURNAL: Agric. Wastes DATE: 1983 VOLUME: 5 NUMBER: 1 PAGES: 1-16
CODEN: AGWADL LANGUAGE: English

6/3/21
98007808 CA: 98(2)7808b JOURNAL
Anaerobic fluidized bed whey treatment
AUTHOR(S): Boening, Paul H.; Larsen, Vidar F.
LOCATION: Biotechnol. Dep., Massey Univ., Palmerston North, N. Z.,
JOURNAL: Biotechnol. Bioeng. DATE: 1982 VOLUME: 24 NUMBER: 11
PAGES: 2539-56 CODEN: BIBIAU ISSN: 0006-3592 LANGUAGE: English

6/3/22
97200693 CA: 97(24)200693t JOURNAL
Anaerobic expanded bed treatment of whey
AUTHOR(S): Switzenbaum, Michael S.; Danskin, Scott C.
LOCATION: Dep. Civ. Eng., Univ. Massachusetts, Amherst, MA, 01003, USA
JOURNAL: Agric. Wastes DATE: 1982 VOLUME: 4 NUMBER: 6 PAGES: 411-26
CODEN: AGWADL LANGUAGE: English

6/3/23
97187593 CA: 97(22)187593p JOURNAL
Anaerobic-filter pretreatment kinetics
AUTHOR(S): Rittmann, Bruce E.; Strubler, Charles E.; Ruzicka, Thomas
LOCATION: Dep. Civ. Eng., Univ. Illinois, Urbana, IL, 61801, USA
JOURNAL: J. Environ. Eng. Div. (Am. Soc. Civ. Eng.) DATE: 1982
VOLUME: 108 NUMBER: EE5 PAGES: 900-12 CODEN: JEEGAV ISSN: 0090-3914
LANGUAGE: English

6/3/24
96222626 CA: 96(26)222626e JOURNAL
ANAMET anaerobic-aerobic treatment of concentrated wastewaters
AUTHOR(S): Frostell, BJorn
LOCATION: AB Sorisons, S-24 00, Staffanstorp, Swed.
JOURNAL: Proc. Ind. Waste Conf. DATE: 1982 VOLUME: 36th, PAGES: 269-7
CODEN: PIWCAX ISSN: 0073-7682 LANGUAGE: English MEETING DATE: 810000

6/3/25
96220460 CA: 96(26)220460x JOURNAL
Anaerobic expanded bed treatment of whey
AUTHOR(S): Switzenbaum, Michael S.; Danskin, Scott C.
LOCATION: Dep. Civ. Environ. Eng., Clarkson Coll. Technol., Potsdam, NY,
13676, USA
JOURNAL: Proc. Ind. Waste Conf. DATE: 1982 VOLUME: 36th, PAGES: 414-2
CODEN: PIWCAX ISSN: 0073-7682 LANGUAGE: English MEETING DATE: 810000

6/3/26
96186671 CA: 96(22)186671e JOURNAL
Anitron and Oxitron systems: high-rate anaerobic and aerobic biological
treatment systems for industry
AUTHOR(S): Sutton, Paul M.; Li, Alan
LOCATION: Berr-Oliver Inc., Stamford, CT, 06904, USA
JOURNAL: Proc. Ind. Waste Conf. DATE: 1982 VOLUME: 36th, PAGES: 665-7
CODEN: PIWCAX ISSN: 0073-7682 LANGUAGE: English MEETING DATE: 810000

6/3/27
96109543 CA: 96(14)109543n CONFERENCE PROCEEDING
Fluidized bed anaerobic digester
AUTHOR(S): Boening, P.; Larsen, V. F.
LOCATION: Dep. Biotechnol., Massey Univ., Palmerston North, N. Z.,
JOURNAL: Chemeca 81 (Eighty-One): Des. Change, Proc. Australas. Chem.
Eng. Conf., 9th EDITOR: Abrahamson, J (Ed), DATE: 1981 PAGES: 527-33
CODEN: 47EYAP LANGUAGE: English PUBLISHER: Chem. Eng. Group, N. Z.
Inst. Eng., Wellington, N. Z

6/3/28
94213946 CA: 94(26)213946r JOURNAL
Feasibility of the upflow anaerobic sludge blanket (UASB) process for the treatment of low-strength wastes
AUTHOR(S): Lettinga, Gatze; Vinken, Johannes N.
LOCATION: Dep. Water Pollut. Control, Agric. Univ., Wageningen, Neth.
JOURNAL: Proc. Ind. Waste Conf. DATE: 1981 VOLUME: 35, PAGES: 625-34
CODEN: PIWCAX ISSN: 0073-7682 LANGUAGE: English MEETING DATE: 80

6/3/29
94180043 CA: 94(22)180043p TECHNICAL REPORT
Anaerobic expanded bed treatment of wastewater
AUTHOR(S): Switzenbaum, M. S.
LOCATION: Clarkson Coll. Technol., Potsdam, NY, USA
JOURNAL: Argonne Natl. Lab., (Tech. Rep.) ANL/CNSV-TM DATE: 1981
NUMBER: ANL/CNSV-TM-50, Anaerobic Filters: Energy Plus Wastewater Treat., 1980 PAGES: 115-27 CODEN: ALTAD7 LANGUAGE: English

6/3/30
94144811 CA: 94(18)144811d JOURNAL
Purification of dairy waste water in a two-stage treatment plant, including anaerobic pretreatment
AUTHOR(S): Vandamme, K.; Wees, G.
LOCATION: Gov. Stn. Res. Dairying, Melle, Belg.
JOURNAL: Milchwissenschaft DATE: 1980 VOLUME: 35 NUMBER: 11
PAGES: 663-6 CODEN: MILCAD ISSN: 0026-3788 LANGUAGE: English

6/3/31
94119525 CA: 94(15)119525f JOURNAL
Anaerobic spore-forming microorganisms in dairy products
AUTHOR(S): Donnelly, L. S.; Busta, F. F.
LOCATION: Dep. Food Sci. Nutr., Univ. Minnesota, St. Paul, MN, 55108, USA
JOURNAL: J. Dairy Sci. DATE: 1981 VOLUME: 64 NUMBER: 1 PAGES: 161-6
CODEN: JDSCAE ISSN: 0022-0302 LANGUAGE: English

6/3/32
94033537 CA: 94(6)33537z CONFERENCE PROCEEDING
Anaerobic sludge digestion in the presence of lactobacillus additive
AUTHOR(S): Ghosh, Sambhunath; Klass, Donald L.
LOCATION: Inst. Gas Technol., Chicago, IL, 60616, USA
JOURNAL: Symp. Pap.: Energy Biomass Wastes 4 (Four) DATE: 1980
PAGES: 295-317 CODEN: 43YSAB LANGUAGE: English PUBLISHER: IGT, Chicago, Ill

6/3/33
93053129 CA: 93(6)53129s CONFERENCE PROCEEDING
Studies of an anaerobic/aerobic treatment process for a strong organic waste
AUTHOR(S): Holder, G. A.; Sewards, G. J.; Scott, P. H.
LOCATION: Dep. Chem. Eng., Monash Univ., Melbourne, Australia
JOURNAL: Water Pollut. Control Dev. Countries: Proc. Int. Conf. EDITOR: Ouano, E. A. R. (Ed); Lohani, B. N. (Ed); Thanh, N. C (Ed), DATE: 1978
VOLUME: 1, PAGES: 539-49 CODEN: 42YOAQ LANGUAGE: English
PUBLISHER: Asian Inst. Technol., Bangkok, Thailand

6/3/34
88141202 CA: 88(20)141202w CONFERENCE PROCEEDING
Treatment of milk processing wastes by methane fermentation, lagoon, and activated sludge processes
AUTHOR(S): Parker, J. G.; Sherry, G. P.
LOCATION: Water Sci. Lab., Carlton, Aust.
JOURNAL: Treat., Recycle Disposal Wastes, Natl. Conf. Chem. Eng., 3rd
EDITOR: Johnston, I. R. W (Ed), DATE: 1975 PAGES: T165-T167

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CODEN: JTUBA  LANGUAGE: English  PUBLISHER: Dep. Chem. Engr., Monash
Univ., Clayton, Aust

 6/3/35
  86194522    CA: 86(26)194522r    JOURNAL
  Nutrient requirements and removal in sewage lagoons
  AUTHOR(S): Parker, C. D.; Skerry, B. P.; Lyons, B. J.
  LOCATION: Water Sci. Lab. Ptv. Ltd., Melbourne, Aust.
  JOURNAL: Prod. Water Technol.  DATE: 1975  VOLUME: 7  NUMBER: 2-3-4
  PAGES: 695-700  CODEN: PGWTA2  LANGUAGE: English

 6/3/36
  80063580    CA: 80(12)63580a    JOURNAL
  Effect of whey admixture on the anaerobic treatment of sewage sludge
  AUTHOR(S): Eriksson, Bernt
  LOCATION: VBB, Stockholm, Swed.
  JOURNAL: Vatten  DATE: 1973  VOLUME: 29  NUMBER: 3  PAGES: 249-68
  CODEN: VTTNAG  LANGUAGE: English

 6/3/37
  79045440    CA: 79(8)45440r    JOURNAL
  Anaerobic digestion of dairy farm slurry
  AUTHOR(S): Bell, C.
  LOCATION: Dep. Biol. Sci., Univ. Surrey, Guildford, Engl.
  JOURNAL: Effluent Water Treat. J.  DATE: 1973  VOLUME: 13  NUMBER: 4
  PAGES: 232-3  CODEN: EWTJAG  LANGUAGE: English

 6/3/38
  72058860    CA: 72(12)58860h    JOURNAL
  Basic processes operating in a lagoon
  AUTHOR(S): Schulze, Karl L.
  LOCATION: Dep. of Civil Eng., Michigan State Univ., East Lansing, Mich
  JOURNAL: Proc. Annu. Nat. Dairy Eng. Conf.  DATE: 1968  VOLUME: 16,
  PAGES: 51-9  CODEN: PNDEAD  LANGUAGE: English
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          $14.49  63 Types in Format  3
           $1.15  5 Types in Format  6
           $0.00  5 Types in Format  8
    $15.64  73 Types
     $2.03  Typenet
    $34.32  Estimated cost this file
    $34.44  Estimated total session cost    0.187 Hrs.

File  50:CAB ABSTRACTS - 1984-86/NOV
SEE ALSO FILE 53 (1972-1983)
** CAB HAS BEEN RELOADED TO FILES 50 AND 53  **
 ** CODES ARE NOW SEARCHABLE AS NUMBER-LETTER **
  **  E.G. S SF=0A ? S AN=0E073-07616           **

      Set  Items  Description
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       S1    1510  ANAEROBIC?
             1510  S1
             2065  WHEY
             9723  DAIRY
       S2     144  (S1 AND (WHEY OR DAIRY))
>>>Term 'ID' is not defined in file 50
             1510  S1
             1110  WHEY/DE,ID
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            S3       45  S1 AND (WHEY OR DAIRY)/DE,ID
            S4       56  S3/ENG
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                      56  S4
                    1907  MANURE
                       0  S0
            S5       46  S4 NOT (MANURE OR S0)
                      46  S5
                    9723  DAIRY
                   25979  CATTLE
                    1457  DAIRY(W)CATTLE
            S6       46  S5 NOT DAIRY()CATTLE
?s s6 not animal? ?

                      46  S6
                   28662  ANIMAL? ?
            S7       38  S6 NOT ANIMAL? ?
?t 7/8/1-5


 7/8/1
  0506947
   Mesophilic anaerobic digestion of dairy cow slurry on a farm scale:
economic considerations.

 Descriptors: methane production; anaerobic treatment; cattle slurry;
    economics; slurries; energy sources; methane; models; simulation model;
     ; composts; production; production costs; dairy farming; uk; cows;
    manures
 Section Heading Codes:   8A56; 0R690008S9; 0D272 ; 8A07; 8A51; 8A09
 Section Headings:     FARM BUILDINGS AND EQUIPMENT - CLEANING AND WASTE
    DISPOSAL (SC=8A56); ECONOMICS OF PRODUCTION - OTHER INPUTS- FUEL AND
    POWER (FROM 1979) (SC=0R69000002/); TECHNOLOGY - DISPOSAL OF WASTES
     (SC=0D270) ; GENERAL - MODELS AND OPERATIONS RESEARCH (FROM 1980
    (SC=8A07); FARM BUILDINGS AND EQUIPMENT - CATTLE (SC=8A51); GENERAL -
    ENERGY (SC=8A09)

 7/8/2
  0497068
   Stability of a percolating anaerobic downflow fixed film reactor under
overloading conditions.

 Descriptors: cows; dairy wastes; anaerobic digesters; whey
 Section Heading Codes:   0D182
 Section Headings:   TECHNOLOGY - WHEY UTILIZATION (SC=0D180)

 7/8/3
  0488043
   Anaerobic digestion of high-strength acidic whey in a pH-controlled
up-flow fixed film loop reactor.

 Descriptors: cows; whey; anaerobic digesters; methane; production
 Section Heading Codes:   0D182 ; 0D720
 Section Headings:     TECHNOLOGY - WHEY UTILIZATION (SC=0D180) ;
    MICROBIOLOGY - MILK PROCESSING AND PRODUCTS (SC=0D720)

 7/8/4
  0482775
   Effect of different neutralizing treatments on the efficiency of an
anaerobic digester fed with deproteinated cheese whey.

 Descriptors: cows; whey; anaerobic digesters; methane; production
 Section Heading Codes:   0D182
 Section Headings:   TECHNOLOGY - WHEY UTILIZATION (SC=0D180)
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 8/3/5
  0476285
     Suppressed methane fermentation of selected industrial wastes: a
 biologically mediated process for conversion of whey to liquid fuel.

    Descriptors: wastes; anaerobic treatment; fuels; production; whey(
       fermentation; cows; hydrocarbons
    Section Heading Codes:   7L5700; 0D182 ; 7L5405; 7L5509
    Section Headings:   INDUSTRIAL WASTES (SC=7L5700); TECHNOLOGY - WHEY
       UTILIZATION   (SC=0D180) ;  BIOLOGICAL WASTE TREATMENT - ANAEROBIC
        DIGESTION    (SC=7L5405);   WASTE DISPOSAL (BIOLOGICAL ASPECTS) -
      BIOLOGICAL UPGRADING - OTHER (SC=7L5509)
 ?s s7 and (whey or biogas or methane)

              38  S7
            2065  WHEY
             393  BIOGAS
             854  METHANE
      S8      30  S7 AND (WHEY OR BIOGAS OR METHANE)
 ?t 8/3/1-15


 8/3/1
  0506947 - BA011-03842
     Mesophilic anaerobic digestion of dairy cow slurry on a farm scale:
 economic considerations.
     Oliver, B.;  Pain, B. F.;  Phillips, V. R.
     Nat. Inst. Agric. Engineering, Silsoe, Bedford MK45 4HS, UK.
     Journal of Agricultural Engineering Research  1986.  34 (3): 229-243  (
  5 ref.)
     Language: English

 8/3/2
  0497068  0D048-06300
     Stability of a percolating anaerobic downflow fixed film reactor under
 overloading conditions.
     Canovas-Diaz, M.;  Howell, J. A.
     Univ. College Swansea, Swansea SA2 8PP, UK.
     Biotechnology Letters  1986.  8 (5): 379-384  (19 ref.)
     Language: English

 8/3/3
  0488043  0D048-05571
     Anaerobic digestion of high-strength acidic whey in a pH-controlled
 up-flow fixed film loop reactor.
     Wildenauer, F. X.;  Winter, J.
     Dep. Microbiol., Univ. Regensburg, Universitatsstrasse 31, 8400
 Regensburg, German Federal Republic.
     Applied Microbiology and Biotechnology  1985.  22 (5): 367-372  (12 ref.
 )
     Language: English

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  0482775  0D048-05005
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APPENDIX B

COPY OF LAB SCALE REACTOR DATA

TABLE B-1 MONITORING DATA FOR LABORATORY-SCALE REACTOR #1.0

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	BIG pH	BIOGASPROD METER L/d	BUBL L/d	SP BIO RATE m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK eq/L	VA eq/L	BA eq/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD eq/L	FILTER COD eq/L	FILTER BOD eq/L	BOD eq/L	TKN eq/L	NH3 eq/L	TP eq/L	TS eq/L	TSS eq/L	VSS eq/L	VSS %	SUPL COD eq/L
	26-Sep-85																														
	27-Sep-85																														
	28-Sep-85																														
	29-Sep-85																														
	30-Sep-85																														
	01-Oct-85																														
1	02-Oct-85	0	0	3.4	33.5	7.65																									
	AVERAGE	0	0	3.4	33.5	7.7																									
2	03-Oct-85	400	0	3.4	35.0	7.46				62.50	1.00																				
3	04-Oct-85	400	0	6.3	36.5	7.35		16.0		62.50	1.00	10171	4822	6699	0.72																
4	05-Oct-85	0	0								0.00																				
5	06-Oct-85	0	0								0.00																				
6	07-Oct-85	400	0	6.1	34.5	7.30		12.5		62.50	1.00	9794	4404	6623	0.66																
7	08-Oct-85	400	0	6.1	36.5	7.30				62.50	1.00																				
8	09-Oct-85	400	0	6.1	36.5	7.29	4.47			62.50	1.00									15510											
	AVERAGE	286	0	5.6	35.8	7.36	4.47	14.6	0.343	62.50	0.77	9983	4613	6661	0.69					15510											
9	10-Oct-85	400	0	4.3	35.0	7.26	13.42			62.50	1.00																				
10	11-Oct-85	400	400	4.3	36.0	7.24	15.29	14.6		31.25	1.09	9566	5747	5368	1.07																1110
11	12-Oct-85	0	0							0.00	0.00																				1110
12	13-Oct-85	0	0							0.00	0.00																				1110
13	14-Oct-85	500	0	4.3						50.00	1.35																				1110
14	15-Oct-85	500	50	3.8	37.0	7.39				45.45	1.35	9841	4448	5838	0.76	57.6	33.9	1.4	0.5												1110
15	16-Oct-85	500	50	3.8	35.5	7.30		16.6		45.45	1.35									16810		5190		1707	1160	315	20140	4425	3150	71.2	1110
	AVERAGE	329	71	4.1	35.9	7.30	14.35	15.6	1.486	33.52	0.89	9274	5090	5603	0.92	57.6	33.9	1.4	0.5	16810		5190		1707	1160	315	20140	4425	3150	71.2	1110
16	17-Oct-85	500	50	4.4	36.0	7.20				45.45	1.35																				1110
17	18-Oct-85	500	50	5.0	37.0	7.22		17.5		45.45	1.35	8614	4930	5064	0.97	49.1	38.8	6.3	0.8												1110
18	19-Oct-85	500	50	5.0		7.10				45.45	1.35																				1110
19	20-Oct-85	500	50	5.0		7.09				45.45	1.35																				1110
20	21-Oct-85	500	50	6.2	32.5	7.10		17.5		45.45	1.35	8311	5486	4361	1.26	51.1	37.4	3.1	0.7												1110
21	22-Oct-85	500	50	3.6	38.0	7.10	14.23			45.45	1.35																				1110
22	23-Oct-85	500	50	5.9	37.0	7.10	11.67	25.2		45.45	1.35									14460							28400	1750	1125	64.3	1110
	AVERAGE	500	50	5.0	36.1	7.14	12.95	20.1	0.593	45.45	1.35	8463	5208	4713	1.12	50.1	38.1	4.7	0.8	14460							28400	1750	1125	64.3	1110
23	24-Oct-85	500	50	6.2	38.0	7.11				45.45	1.35																				1110
24	25-Oct-85	500	50	6.1	35.5	7.10		20.2		45.45	1.35	7748	5367	3876	1.38																1110
25	26-Oct-85	500	50	6.2	36.0	7.10				45.45	1.35																				1110
26	27-Oct-85	500	50	6.2	38.0	7.05				45.45	1.35																				1110
27	28-Oct-85	500	50	6.2	35.0	7.00		21.0		45.45	1.35	7145	5389	3319	1.62	52.4	37.2	5.4	0.8												1110
28	29-Oct-85	500	50	6.2	34.0	6.95				45.45	1.35																				1110
29	30-Oct-85	500	100	6.2	35.5	6.90		16.3		41.67	1.35									15440		6720		1627	920	350	19160	2825	2325	82.3	1110
	AVERAGE	500	57	6.2	36.0	7.03		19.4		44.91	1.35	7443	5378	3598	1.50	52.4	37.2	5.4	0.8	15440		6720		1627	920	350	19160	2825	2325	82.3	1110

TABLE B-1 MONITORING DATA FOR LABORATORY-SCALE REACTOR 01.0 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	DIG pH	BIOGASPROD METER L/d	BUBL L/d	SP BIO RATE m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	FILTER COD mg/L	FILTER COD mg/L	BOD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
30	31-Oct-85	500	100	6.1	35.0	6.90	18.16			41.67	1.35					53.1	38.5	2.4	0.7												1110
31	01-Nov-85	500	100	6.1	35.5	6.95	28.83	13.9		41.67	1.35	6574	5109	2090	1.80																1110
32	02-Nov-85	500	100	6.1	38.0	6.90	16.12			41.67	1.35																				1110
33	03-Nov-85	500	100	6.1	37.0	6.82	20.20			41.67	1.35																				1110
34	04-Nov-85	500	100	6.1	36.5	6.95	19.35	16.8		41.67	1.35	6209	4937	2784	1.77	53.1	36.2	2.4	0.7												1110
35	05-Nov-85	500	100	6.2	35.0	6.95	13.20			41.67	1.35																				1110
36	06-Nov-85	500	100	6.1	35.0	7.05	12.55	13.2		41.67	1.35									16550							19250	2825	1500	74.1	1110
	AVERAGE	500	100	6.1	36.0	6.93	18.40	14.6	0.772	41.67	1.35	6432	5063	2837	1.79	53.1	37.4	2.4	0.7	16550							19250	2825	1500	74.1	1110
37	07-Nov-85	500	100	6.2	35.0	7.00				41.67	1.35																				1110
38	08-Nov-85	500	100	5.2	36.0	6.90		17.8		41.67	1.35	5867	4597	2604	1.76																1110
39	09-Nov-85	500	100	6.2	33.0	6.90				41.67	1.35																				1110
40	10-Nov-85	500	100	6.2	35.0	7.00				41.67	1.35																				1110
41	11-Nov-85	550	100	6.2	34.0	6.94		22.8		38.46	1.49	5644	4107	2720	1.51	55.4	38.4	2.5	0.6												1110
42	12-Nov-85	550	100	6.2	35.0	6.80				38.46	1.49																				1110
43	13-Nov-85	550	100	5.7	36.0	6.80		21.8		38.46	1.49									16580		4420		1500	680	365	18700	2450	1825	74.5	1110
	AVERAGE	521	100	6.0	34.9	6.91	0.00	20.8	0.000	40.29	1.41	5756	4352	2666	1.64	55.4	38.4	2.5	0.6	16580		4420		1500	680	365	18700	2450	1825	74.5	1110
44	14-Nov-85	550	100	6.2	35.0	6.90	18.67			38.46	1.49					51.6	33.8	3.3	1.1												1110
45	15-Nov-85	550	100	6.2	34.5	6.85	22.37	17.8		38.46	1.49	5272	3884	2514	1.54																1110
46	16-Nov-85	600	100	6.2	34.0	6.90	18.84			35.71	1.62																				1110
47	17-Nov-85	600	100	6.2	35.0	6.90	22.89			35.71	1.62																				1110
48	18-Nov-85	600	100	4.7	35.0	6.90	19.85	18.0		35.71	1.62	4962	3558	2436	1.46																1110
49	19-Nov-85	600	100	6.1	38.0	6.90	20.21			35.71	1.62																				1110
50	20-Nov-85	600	100	4.1	36.5	6.95		21.2		35.71	1.62									16450							18200	2250			1110
	AVERAGE	586	100	5.7	35.4	6.90	20.20	18.7	0.715	36.58	1.58	5117	3721	2475	1.50	51.6	33.8	3.3	1.1	16450							18200	2250			1110
51	21-Nov-85	600	100	6.2	34.0	6.99				35.71	1.62					57.5	35.7	2.0	0.6												1110
52	22-Nov-85	600	100	4.5	35.0	6.90		23.8		35.71	1.62	4664	3186	2737	1.13																1110
53	23-Nov-85	600	100	4.5	35.0	7.00				35.71	1.62																				1110
54	24-Nov-85	600	100	4.5	34.5	6.92				35.71	1.62																				1110
55	25-Nov-85	600	100	6.2	34.5	6.90		23.3		35.71	1.62	4540	2721	2600	1.04																1110
56	26-Nov-85	650	100	6.2	35.0	6.95				33.33	1.75					53.5	37.6	2.1	0.6												1110
57	27-Nov-85	650	100	6.2	35.0	6.91		21.6		33.33	1.75									15320		2390		1500	570	360	17000	2675	2150	80.4	1190
	AVERAGE	614	100	5.5	34.7	6.94	0.00	22.9	0.000	35.03	1.66	4602	2914	2673	1.09	55.5	36.7	2.1	0.6	15320		2390		1500	570	360	17000	2675	2150	80.4	1121
58	28-Nov-85	650	100	6.2	35.0	6.90	29.04			33.33	1.75																				1190
59	29-Nov-85	650	100	5.2	35.5	7.00	25.86	21.8		33.33	1.75	4346	2350	2698	0.87	57.1	38.4	1.6	0.5												1190
60	30-Nov-85	650	100	6.1	35.0	7.01	27.09			33.33	1.75																				1190
61	01-Dec-85	0	0								0.00																				1190
62	02-Dec-85	650	100	6.2	34.0	7.30				33.33	1.75	4483	971	3714	0.26																1190
63	03-Dec-85	650	100	6.2	35.0	7.15				33.33	1.75					57.9	35.7	2.1	0.5												1190
64	04-Dec-85	650	100	6.2	36.0	7.05	22.36	27.6		33.33	1.75									14520							15630	2300	1625	70.7	1190
	AVERAGE	557	86	6.0	35.1	7.07	26.09	24.7	0.977	33.33	1.50	4385	1661	3206	0.57	57.5	37.1	1.9	0.5	14520							15630	2300	1625	70.7	1190

TABLE B-1 MONITORING DATA FOR LABORATORY-SCALE REACTOR 01.0 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	DIG pH	BIOGASPROD METER L/d	BUBL L/d	SP BIO RATE m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	BOD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
65	05-Dec-85	650	100	5.4	35.5	7.05				33.33	1.75					56.5	38.5	1.7	0.5												1190
66	06-Dec-85	650	100	4.7	35.5	7.01	24.13	25.9		33.33	1.76	4217	1186	3375	0.35																1440
67	07-Dec-85	700	100	4.5	35.0	7.06				31.25	1.89																				1440
68	08-Dec-85	700	100	4.5	35.0	7.00	24.00			31.25	1.89																				1440
69	09-Dec-85	700	100	6.1	35.0	6.99		23.8		31.25	1.89	3845	1312	2914	0.45	54.4	38.1	2.3	0.7												1440
70	10-Dec-85	700	100	6.2	35.5	6.95	25.32			31.25	1.89																				1440
71	11-Dec-85	700	100	6.2	35.5	6.95				31.25	1.89									13530		1630		1429	545	268	15670	2350	2000	85.1	1440
	AVERAGE	686	100	5.4	35.3	6.99	24.51	24.8	0.607	31.85	1.85	4031	1249	3145	0.40	55.5	38.3	2.0	0.6	13530		1630		1429	545	268	15670	2350	2000	85.1	1404
72	12-Dec-85	700	100	6.2	35.0	6.95	26.66			31.25	1.89																				1440
73	13-Dec-85	700	100	6.2	35.0	6.93		25.9		31.25	1.89	3659	1497	2596	0.58																1440
74	14-Dec-85	700	100	6.2	35.0	6.95	25.66			31.25	1.89																				1440
75	15-Dec-85	700	100	6.2	35.0	6.95				31.25	1.89																				1440
76	16-Dec-85	700	100	6.2	35.0	7.00	22.20	27.8		31.25	1.89	3535	1201	2602	0.45	54.4	37.8	2.1	0.6												1440
77	17-Dec-85	800	120	6.2	34.5	7.00				27.17	2.16																				1440
78	18-Dec-85	800	120	6.4	34.5	7.00	24.44	27.1		27.17	2.16									13550							15090	2200	1875	85.2	1440
	AVERAGE	729	104	6.2	34.9	6.97	24.24	26.9	0.639	30.09	1.97	3597	1349	2639	0.52	54.4	37.8	2.1	0.6	13550							15090	2200	1875	85.2	1440
79	19-Dec-85	800	120	5.7	34.0	7.00				27.17	2.16																				1440
80	20-Dec-85	800	120	5.9	34.0	7.00	23.84	28.1		27.17	2.16	2717	1148	1902	0.60	55.6	37.8	2.2	0.7												1440
81	21-Dec-85	800	120	6.2	35.0	7.00				27.17	2.16																				1440
82	22-Dec-85	800	120	6.2	35.0	6.95	22.05			27.17	2.16																				1440
83	23-Dec-85	800	120	6.3	35.0	7.00		31.7		27.17	2.16	3175	935	2497	0.38																1440
84	24-Dec-85	900	135	5.9	35.0	7.03	26.52			24.15	2.43																				1440
85	25-Dec-85	900	135	5.9	35.0					24.15	2.43									13450		4200		1286	460	291	15670	2425	1925	79.4	1440
	AVERAGE	829	124	6.0	35.3	7.00	23.87	29.9	0.553	26.31	2.24	2946	1052	2200	0.49	55.6	37.8	2.2	0.7	13450		4200		1286	460	291	15670	2425	1925	79.4	1440
86	26-Dec-85	900	135	6.2	34.0					24.15	2.43																				1440
87	27-Dec-85	900	135	6.1	35.0	7.00	24.60			24.15	2.43	2977	976	2284	0.43																1440
88	28-Dec-85	900	135	6.2	35.0	6.96				24.15	2.43																				1440
89	29-Dec-85	1000	150	6.2	35.0	6.98	24.75			21.74	2.70																				1440
90	30-Dec-85	1000	150	6.3	35.0	6.90		31.9		21.74	2.70	2791	1251	1903	0.66	54.7	38.9	1.8	0.5												1440
91	31-Dec-85	1000	150	6.2	35.0	6.93	27.92			21.74	2.70																				1440
92	01-Jan-86	1000	150	6.2	35.0	6.90				21.74	2.70									14320							14950	3400	2900	85.3	1440
	AVERAGE	957	144	6.2	34.9	6.95	25.76	31.9	0.527	22.77	2.58	2884	1114	2094	0.55	54.7	38.9	1.8	0.5	14320							14950	3400	2900	85.3	1440
93	02-Jan-86	1000	150	6.4	35.0	6.82	26.32			21.74	2.70	2635	1622	1503	1.08	53.2	39.7	1.9	0.5												1440
94	03-Jan-86	900	135	6.2	35.5	6.77				24.15	2.43	2679	1931	1368	1.48																1440
95	04-Jan-86	900	135	6.2	35.0	6.81	24.90			24.15	2.43																				1440
96	05-Jan-86	900	135	6.2	35.0	6.83				24.15	2.43																				1440
97	06-Jan-86	900	135	6.3	35.0	6.70	26.93	31.2		24.15	2.43	2605	2062	1141	1.81	52.7	36.5	2.5	0.7												1440
98	07-Jan-86	800	120	6.9	35.0	6.70				27.17	2.16																				1440
99	08-Jan-86	860	129	5.1	35.0	6.71	26.94	31.7		27.17	2.16									15770		7470					15450	4750	4275	90.0	1440
	AVERAGE	886	133	5.9	35.1	6.76	26.27	31.5	0.600	24.67	2.39	2646	1872	1317	1.46	53.0	38.1	2.2	0.6	15770		7470					15450	4750	4275	90.0	1440

TABLE B-1 MONITORING DATA FOR LABORATORY-SCALE REACTOR 81.0 (CONT'D)

DAY	DATE	WWEY mL	SUPL mL	WWEY pH	TEMP C	BIO pH	BIOGASPROD METER L/d	SP BIO GAS PROD RATE BUBL L/d	a3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VR mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	FILTER BOD mg/L	BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
100	09-Jan-86	400	60	3.9	35.0	6.65				54.35	1.00					53.4	38.1	2.3	0.6												1390
101	10-Jan-86	400	60	6.2	35.0	6.80	26.21			54.35	1.00	2754	2041	1305	1.56																1390
102	11-Jan-86	400	60	6.2	35.0	6.95				54.35	1.00																				1390
103	12-Jan-86	400	60	6.2	35.0	7.10	21.56			54.35	1.00																				1390
104	13-Jan-86	400	60	6.3	35.0	7.14				54.35	1.00	3076	983	2378	0.41																1390
105	14-Jan-86	600	90	5.4	32.0	7.09	18.66			36.23	1.62					58.0	32.5	3.2	1.0												1390
106	15-Jan-86	600	90	5.2	34.0	7.05	22.31			36.23	1.62									13640						14190	6000	5350	89.2		1390
	AVERAGE	457	69	5.6	34.4	6.97	22.18	0.927	49.17	1.23		2915	1512	1842	0.99	56.1	35.3	2.8	0.8	13640						14190	6000	5350	89.2		1390
107	16-Jan-86	600	90	4.9	36.0	7.07				36.23	1.62																				1390
108	17-Jan-86	600	90	4.4	35.0	7.09	24.31			36.23	1.62	3225	722	2712	0.27																1390
109	18-Jan-86	700	105	6.1	35.0	7.10				31.06	1.89																				1390
110	19-Jan-86	700	105	6.1	35.5	7.00	25.56			31.06	1.89																				1390
111	20-Jan-86	700	105	6.0	35.0	7.05				31.06	1.89	3175	509	2814	0.18	56.3	33.1	2.6	0.8												1390
112	21-Jan-86	800	120	6.0	35.0	7.05	25.65			27.17	2.16																				1380
113	22-Jan-86	800	120	6.1	34.0	7.10	25.49			27.17	2.16									11020			2370			12310	5000	4900	84.5		1380
	AVERAGE	700	105	5.7	35.1	7.08	25.25	0.656	31.43	1.89		3200	616	2763	0.23	56.3	33.1	2.6	0.8	11020			2370			12310	5000	4900	84.5		1387
114	23-Jan-86	800	120	6.4	34.0	6.90				27.17	2.16					55.9	35.1	3.0	1.0												1789
115	24-Jan-86	800	120	6.3	34.5	7.02	27.96			27.17	2.16	2892	447	257[illegible]	0.17																1789
116	25-Jan-86	800	120	6.4	36.0	7.02				27.17	2.16																				1789
117	26-Jan-86	800	120	6.4	33.0	7.00	26.52			27.17	2.16																				1789
118	27-Jan-86	800	120	6.3	34.0	7.00				27.17	2.16	2682	399	2399	0.17	55.4	35.4	2.7	0.9												1789
119	28-Jan-86	900	135	6.3	35.0	6.99	27.34			24.15	2.43																				1789
120	29-Jan-86	900	135	6.3	35.0	7.00				24.15	2.43									11910						13310	3700	3250	87.8		1789
	AVERAGE	829	124	6.3	34.5	7.00	27.20	0.611	26.31	2.24		2787	423	2487	0.17	55.7	35.3	2.9	1.0	11910						13310	3700	3250	87.8		1789
121	30-Jan-86	900	135	6.3	35.0	7.01	36.70			24.15	2.43																				1510
122	31-Jan-86	900	135	6.5	35.0	6.98				24.15	2.43	2411	529	2035	0.26																1510
123	01-Feb-86	900	135	6.2	35.0	6.96	35.58			24.15	2.43																				1510
124	02-Feb-86	900	135	6.2	32.0	6.90				24.15	2.43																				1510
125	03-Feb-86	900	135	6.1	35.0	6.89	38.00			24.15	2.43	2243	687	1735	0.39	56.0	37.1	1.5	0.4												1510
126	04-Feb-86	900	135	6.2	35.0	6.90				24.15	2.43																				1510
127	05-Feb-86	900	135	6.2	35.0		36.26			24.15	2.43									12190	2997	3440	840			13540	4300	3750	87.2		1510
	AVERAGE	900	135	6.0	34.6	6.94	36.63	0.761	24.15	2.43		2327	608	1895	0.33	56.0	37.1	1.5	0.4	12190	2997	3440	840			13540	4300	3750	87.2		1510
128	06-Feb-86	900	135	6.2	34.5	6.90				24.15	2.43					56.7	37.7	1.6	0.4												1510
129	07-Feb-86	900	135	6.0	34.0	6.85	33.78			24.15	2.43	2184	1665	1340	0.79																1510
130	08-Feb-86	900	135	6.3	35.0	6.78				24.15	2.43																				1510
131	09-Feb-86	700	105	6.3	35.0	6.73	36.63			31.06	1.89																				1510
132	10-Feb-86	700	105	6.2	34.0	6.80				31.06	1.89	2113	1118	1319	0.85	57.0	34.7	1.6	0.5												1510
133	11-Feb-86	700	105	6.2	35.0	6.78	30.49			31.06	1.89																				1510
134	12-Feb-86	700	105	6.4	34.5	6.84				31.06	1.89									13150						14100	5550	5250	94.6		1510
	AVERAGE	786	118	5.9	34.6	6.81	33.63	0.813	28.10	2.12		2189	1092	1334	0.82	56.9	36.2	1.6	0.5	13150						14100	5550	5250	94.6		1510

TABLE B-1 MONITORING DATA FOR LABORATORY-SCALE REACTOR R1.0 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	BIG pH	BIOGASPROD METER L/d	BP BIO RATE BUBL L/d	m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	BOD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
135	13-Feb-86	700	105	5.7	34.0	6.87	33.34			31.06	1.89					58.7	33.9	1.5	0.4												1600
136	14-Feb-86	700	105	4.9	34.0	6.91				31.06	1.89	2290	741	1764	0.42																1600
137	15-Feb-86	800	120	6.3	35.0	6.90	31.36			27.17	2.16																				1600
138	16-Feb-86	800	120	6.3	35.0	6.91				27.17	2.16																				1600
139	17-Feb-86	800	120	6.3	34.0	6.90	37.19			27.17	2.16	2300	601	1881	0.32	56.9	34.4	1.6	0.5												1600
140	18-Feb-86	800	120		35.0					27.17	2.16																				1600
141	19-Feb-86	800	120		34.0		31.00			27.17	2.16									13000	1640	3260	890				13720	6350	5250	82.7	1600
	AVERAGE	771	116	5.9	35.0	6.90	33.44		0.823	28.28	2.00	2299	671	1823	0.37	57.8	35.2	1.6	0.5	13000	1640	3260	890				13720	6350	5250	82.7	1600
142	20-Feb-86	0	0		34.0	6.90					0.00					57.7	33.4	1.9	0.7												1600
143	21-Feb-86	800	120	6.4	34.0	7.00	6.97			27.17	2.16	2327	298	2115	0.14																1600
144	22-Feb-86	800	120	6.4	34.0	6.95				27.17	2.16																				1600
145	23-Feb-86	800	120	6.4	35.0	6.94	30.15			27.17	2.16																				1600
146	24-Feb-86	800	120	6.2	34.0	6.90				27.17	2.16	2290	369	2020	0.18	56.7	35.6	1.9	0.6												1600
147	25-Feb-86	850	120	6.0	35.0	6.90	31.07			25.56	2.30																				1600
148	26-Feb-86	850	120	6.1	35.0	6.95				25.56	2.30									12110							13230	8750	6600	75.4	2160
	AVERAGE	700	105	6.3	34.7	6.93	23.00		0.640	26.64	1.09	2309	334	2072	0.16	57.2	34.5	1.9	0.7	12110							13230	8750	6600	75.4	1600
149	27-Feb-86	850	120	6.3	34.0	6.96	34.76			25.56	2.30					56.2	34.3	1.4	0.4												2160
150	28-Feb-86	850	120	5.7	35.0	6.96				25.56	2.30	2234	482	1892	0.25																2160
151	01-Mar-86	850	120	6.1	36.0	6.96	32.20			25.56	2.30																				2160
152	02-Mar-86	850	120	6.1	36.0	6.96				25.56	2.30																				2160
153	03-Mar-86	850	120	6.0	35.0	6.92	32.16			25.56	2.30	2150	476	1812	0.26	56.9	34.8	1.6	0.5												2160
154	04-Mar-86	900	135	6.2	35.0	6.92				24.15	2.43																				2160
155	05-Mar-86	900	135	6.3	34.0	6.90	30.43			24.15	2.43									12920	1550	2810	680				14130	7050	6450	91.5	2160
	AVERAGE	864	130	6.1	35.0	6.94	32.41		0.711	25.16	2.34	2192	479	1852	0.26	56.6	35.6	1.5	0.5	12920	1550	2810	680				14130	7050	6450	91.5	2160
156	06-Mar-86	900	135	6.3	35.0	6.88				24.15	2.43					55.3	36.2	1.4	0.4												2160
157	07-Mar-86	900	135	6.0	34.0	6.80	34.78			24.15	2.43	2039	898	1401	0.64																2160
158	08-Mar-86	900	135	6.0	35.0	6.80				24.15	2.43																				2160
159	09-Mar-86	900	135	6.0	35.0	6.72	34.22			24.15	2.43																				2160
160	10-Mar-86	900	135	6.3	36.0	6.80				24.15	2.43	2040	1154	1229	0.94	55.2	35.1	1.6	0.5												2160
161	11-Mar-86	800	120	6.0	35.0	6.78	30.32			27.17	2.16																				1920
162	12-Mar-86	700	105	6.1	35.0	6.75				31.06	1.89									14010							13960	7600	6950	91.4	1920
	AVERAGE	857	129	6.1	35.0	6.79	33.77		0.800	25.57	2.32	2044	1026	1315	0.79	55.3	35.7	1.5	0.5	14010							13960	7600	6950	91.4	2091
163	13-Mar-86	700	105	6.1	35.0	6.80	34.60			31.06	1.89					55.9	33.3	1.4	0.4												1920
164	14-Mar-86	700	105	6.2	36.0	6.87				31.06	1.89	2005	863	1472	0.59																1920
165	15-Mar-86	800	120	6.2	36.0	6.90	25.37			27.17	2.16																				1920
166	16-Mar-86	800	120	6.2	35.0	6.90				27.17	2.16																				1920
167	17-Mar-86	800	120	6.0	35.0	6.95	26.20			27.17	2.16	2122	375	1856	0.20	58.4	33.6	1.6	0.5												1920
168	18-Mar-86	800	120	6.2	35.5	6.90				27.17	2.16																				1920
169	19-Mar-86	800	120	5.3	35.0	7.00	28.04			27.17	2.16									13620	1215	2220	190				13920	7150	6350	91.6	1810
	AVERAGE	771	116	6.0	35.4	6.94	28.77		0.717	28.28	2.09	2164	619	1664	0.40	57.2	33.5	1.5	0.5	13620	1215	2220	190				13920	7150	6350	91.6	1984

TABLE B-1 MONITORING DATA FOR LABORATORY-SCALE REACTOR R1.0 (CONT'D)

DAY	DATE	WWEY	SUPL	WWEY	TEMP	DIG	BIOGASPROD METER	DP DIG BUBL	RATE	HRT	LOAD RATE	ALK	VA	BA	VA/BA	BIOGAS QUALITY CH4	CO2	N2	O2	COD	FILTER COD	FILTER BOD	TKN	NH3	TP	TS	TDS	VSS	VSS	SUPL COD
		gL	gL	pH	C	pH	L/d	L/d	gCOD UR	d	g/d	mg/L	mg/L	mg/L		%	%	%	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	%	mg/L
170	20-Mar-86	800	120	6.2	35.0	6.99			27.17	2.16						59.3	33.6	2.0	0.7											1810
171	21-Mar-86	800	120	6.0	35.0	6.93	23.77		27.17	2.16	2187	324	1957	0.17																1810
172	22-Mar-86	800	120	6.0	35.0	6.92			27.17	2.16																				1810
173	23-Mar-86	800	120	6.0	35.0	6.91	22.39		27.17	2.16																				1810
174	24-Mar-86	800	120	6.0	36.0	6.92			27.17	2.16	2150	250	1973	0.13		60.2	35.1	2.1	0.7											1810
175	25-Mar-86	800	120	6.2	35.0	6.91	23.97		27.17	2.16																				1810
176	26-Mar-86	800	120	6.2	35.0	6.90			27.17	2.16										12650					13400	6350	5950	93.7	1810
	AVERAGE	800	120	6.1	35.1	6.93	23.38	0.551	27.17	2.16	2169	287	1965	0.15		59.8	34.4	2.1	0.7	12650					13400	6350	5950	93.7	1810
177	27-Mar-86	800	120	6.1	35.0	6.90	27.39		27.17	2.16						58.1	36.7	1.6	0.5											1810
178	28-Mar-86	800	120	6.2	35.0				27.17	2.16																				1810
179	29-Mar-86	800	120	6.2	35.0				27.17	2.16																				1810
180	30-Mar-86	800	120	6.2	35.0				27.17	2.16																				1810
181	31-Mar-86	800	120	6.2	35.0				27.17	2.16																				1810
182	01-Apr-86	800	120	6.2	35.0				27.17	2.16																				1810
183	02-Apr-86	800	120	6.2	35.0				27.17	2.16																				1810
	AVERAGE	800	120	6.2	35.0	6.90	27.39		27.17	2.16						58.1	36.7	1.6	0.5											1810
184	03-Apr-86	850	120		35.0	6.93			25.58	2.30	2300	309	2009	0.15						12100										1810
185	04-Apr-86	850	120		35.0				25.58	2.30																				1810
186	05-Apr-86	850	120		35.0				25.58	2.30																				1810
187	06-Apr-86	850	120		35.0				25.58	2.30																				1810
188	07-Apr-86	850	120		35.0				25.58	2.30																				1810
189	08-Apr-86	850	120		35.0				25.58	2.30																				1810
190	09-Apr-86	850	120		35.0				25.58	2.30																				1810
	AVERAGE	850	120		35.0	6.93			25.58	2.30	2300	309	2009	0.15						12100										1810
191	10-Apr-86	850	120		35.0				25.58	2.30	2625	1094	1048	0.59						12500										1810
192	11-Apr-86	850	120		35.0				25.58	2.30																				1810
193	12-Apr-86	850	120		35.0				25.58	2.30																				1810
194	13-Apr-86	850	120		35.0				25.58	2.30																				1810
195	14-Apr-86	850	120		35.0				25.58	2.30																				1810
196	15-Apr-86	850	120		35.0				25.58	2.30																				1810
197	16-Apr-86	850	120		35.0				25.58	2.30																				1810
	AVERAGE	850	120		35.0				25.58	2.30	2625	1094	1048	0.59						12500										1810
198	17-Apr-86	850	120		35.0	6.78			25.58	2.30	2569	1171	1738	0.67						12090										1810
199	18-Apr-86	700	105		35.0				31.06	1.89																				1810
200	19-Apr-86	700	105		35.0				31.06	1.89																				1810
201	20-Apr-86	700	105		35.0				31.06	1.89																				1810
202	21-Apr-86	700	105		35.0				31.06	1.89																				1810
203	22-Apr-86	700	105		35.0				31.06	1.89																				1810
204	23-Apr-86	700	105		35.0				31.06	1.89																				1810
	AVERAGE	721	100		35.0	6.78			30.27	1.95	2569	1171	1738	0.67						12090										1810

TABLE B-1 MONITORING DATA FOR LABORATORY-SCALE REACTOR 01.0 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	DIG pH	BIOGASPROD METER L/d	SP BIO RATE BUBL L/d	m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	FILTER COD mg/L	FILTER BOD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
205	24-Apr-86	700	105		35.0	6.95				31.86	1.89	2457	486	2112	0.23					12570										1810
206	25-Apr-86	800	80		35.0					28.41	2.16																			1810
207	26-Apr-86	800	80		35.0					28.41	2.16																			1810
208	27-Apr-86	800	80		35.0					28.41	2.16																			1810
209	28-Apr-86	800	80		35.0					28.41	2.16																			1810
210	29-Apr-86	800	80		35.0					28.41	2.16																			1810
211	30-Apr-86	800	80		35.0					28.41	2.16																			
	AVERAGE	786	84		35.0	6.95				28.79	2.12	2457	486	2112	0.23					12570										1810
212	01-May-86	800	80		35.0	6.90				28.41	2.16	2388	741	1782	0.42					10950										1810
213	02-May-86	800	80		35.0					28.41	2.16																			1810
214	03-May-86	800	80		35.0					28.41	2.16																			1810
215	04-May-86	800	80		35.0					28.41	2.16																			1810
216	05-May-86	800	80		35.0					28.41	2.16																			1810
217	06-May-86	800	80		35.0					28.41	2.16																			1810
218	07-May-86	800	80		35.0					28.41	2.16																			
	AVERAGE	800	80		35.0	6.90				28.41	2.16	2388	741	1782	0.42					10950										1810
219	08-May-86	800	80		35.0	6.83				28.41	2.16	2336	533	1958	0.27					11960										1810
220	09-May-86	800	80		35.0					28.41	2.16																			1810
221	10-May-86	800	80		35.0					28.41	2.16																			1810
222	11-May-86	800	80		35.0					28.41	2.16																			1810
223	12-May-86	800	80		35.0					28.41	2.16																			1810
224	13-May-86	800	80		35.0					28.41	2.16																			1810
225	14-May-86	800	80		35.0					28.41	2.16																			
	AVERAGE	800	80		35.0	6.83				28.41	2.16	2336	533	1958	0.27					11960										1810
226	15-May-86	800	80		35.0	6.56				28.41	2.16	2271	1774	1012	1.75					15090										1810
227	16-May-86	800	80		35.0					28.41	2.16																			1810
228	17-May-86	800	80		35.0					28.41	2.16																			1810
229	18-May-86	800	80		35.0					28.41	2.16																			1810
230	19-May-86	800	80		35.0					28.41	2.16																			1810
231	20-May-86	800	80		35.0					28.41	2.16																			1810
232	21-May-86	800	80		35.0					28.41	2.16																			
	AVERAGE	800	80		35.0	6.56				28.41	2.16	2271	1774	1012	1.75					15090										1810
233	22-May-86	800	80		35.0	6.41				28.41	2.16	2290	2164	754	2.87					18004										1810
234	23-May-86																													
235	24-May-86																													
236	25-May-86																													
237	26-May-86																													
238	27-May-86																													
239	28-May-86																													
	AVERAGE	800	80		35.0	6.41				28.41	2.16	2290	2164	754	2.87					18004										1810

TABLE B-2 MONITORING DATA FOR LABORATORY-SCALE REACTOR #2.0

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	DIG pH	BIOGAS METER L/d	BIOGASPROD BUBL L/d	SP BIO RATE m3/kg COD UR	HRT d	LOAD RATE g/d	ALK eq/L	VA eq/L	BA eq/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	FILTER COD COD eq/L	FILTER BOD BOD eq/L	TKN eq/L	NH3 eq/L	TP eq/L	TS eq/L	TSS eq/L	VSS eq/L	VSS %	SUPL COD eq/L
	19-Sep-85																												10350
	20-Sep-85																												10350
	21-Sep-85																												10350
	22-Sep-85																												10350
	23-Sep-85																												10350
1	24-Sep-85	400	0	6.2	32.5	7.55				62.50	1.00																		
2	25-Sep-85	400	0	6.2	35.0	7.40		13.9		62.50	1.00	10830	3919	8040	0.49														10350
	AVERAGE	400	0	6.2	33.8	7.48		13.9		62.50	1.00	10830	3919	8040	0.49														10350
3	26-Sep-85	400	0	3.4	37.0	7.27				62.50	1.00																		10350
4	27-Sep-85	400	0	3.5	36.5	7.25		16.3		62.50	1.00																		10350
5	28-Sep-85	0	0								0.00																		10350
6	29-Sep-85	0	0								0.00																		10350
7	30-Sep-85	400	400	6.1	35.5	7.21		38.2		31.25	1.37	10504	6112	6164	0.99														10350
8	01-Oct-85	400	0	4.2	34.0	7.21				62.50	1.00																		
9	02-Oct-85	400	0	3.4	33.5	7.22		14.4		62.50	1.00					35.3	49.5	3.7	0.2	18040	9410	1793	1287	290					10350
	AVERAGE	284	57	4.1	35.3	7.23		23.0		72.92	0.81	10504	6112	6164	0.99	35.3	49.5	3.7	0.2	18040	9410	1793	1287	290					10350
10	03-Oct-85	400	0	3.4	35.0	7.00				62.50	1.00																		10350
11	04-Oct-85	400	0	6.3	36.5	7.10		16.6		62.50	1.00	10234	7554	4795	1.58														10350
12	05-Oct-85	0	0								0.00																		10350
13	06-Oct-85	0	0								0.00																		10350
14	07-Oct-85	400	0	6.1	34.5	7.10		9.4		62.50	1.00	9656	7725	4094	1.89														10350
15	08-Oct-85	400	0	6.1	36.5	7.05				62.50	1.00																		
16	09-Oct-85	400	0	6.1	36.5	7.00				62.50	1.00									18420									
	AVERAGE	284	0	5.6	35.8	7.07		13.0		87.50	0.77	9945	7640	4445	1.73					18420									10350
17	10-Oct-85	400	0	4.3	35.0	7.00				62.50	1.00																		10350
18	11-Oct-85	400	400	4.3	36.0	6.80		14.4		31.25	1.37	10272	8621	4065	2.12														10350
19	12-Oct-85	0	0								0.00																		10350
20	13-Oct-85	0	0								0.00																		10350
21	14-Oct-85	500	0	4.3						50.00	1.35																		10350
22	15-Oct-85	500	50	3.8	37.0	7.02				45.45	1.38	9292	7969	3554	2.24	49.3	41.5	1.1	0.3										
23	16-Oct-85	500	50	3.8	35.5	6.92	12.84	15.8		45.45	1.38									20750	10140	1793	1107	340	22000	2000	2600	92.9	10350
	AVERAGE	329	71	4.1	35.9	6.96	12.84	15.1	0.849	62.50	0.94	9782	8295	3810	2.10	49.3	41.5	1.1	0.3	20750	10140	1793	1107	340	22000	2000	2600	92.9	10350
24	17-Oct-85	500	50	4.4	36.0	6.80	12.79			45.45	1.38																		10350
25	18-Oct-85	500	50	5.0	37.0	6.85	12.69	14.2		45.45	1.38	8602	8858	2800	2.88	42.5	44.6	3.9	0.7										10350
26	19-Oct-85	500	50	5.0		6.79				45.45	1.38																		10350
27	20-Oct-85	500	50	5.0		6.72				45.45	1.38																		10350
28	21-Oct-85	500	50	6.2	32.5	6.70		16.3		45.45	1.38	8468	8777	2141	4.10														10350
29	22-Oct-85	500	400	3.6	38.0	6.65				27.78	1.64					42.7	41.8	3.6	0.6										
30	23-Oct-85	500	400	5.9	37.0	6.70		17.3		27.78	1.64									21740					22350	2650	1925	72.6	10350
	AVERAGE	500	150	5.0	36.1	6.74	12.74	15.9	0.572	38.46	1.46	8531	8418	2471	3.49	42.6	43.2	3.8	0.7	21740					22350	2650	1925	72.6	10350

TABLE B-2 MONITORING DATA FOR LABORATORY-SCALE REACTOR #2.0 (CONT'D)

DAY	DATE	INFV mL	SUPL mL	INFV pH	TEMP C	DIG pH	BIOGASPROD METER L/d	BIOGASPROD BUBL L/d	SP BIO RATE g3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
31	24-Oct-85	500	50	6.2	38.0	6.80	6.25			45.45	1.38																		18350
32	25-Oct-85	500	50	6.1	35.5	6.80		15.0		45.45	1.46	8149	8377	2108	3.96														58490
33	26-Oct-85	500	50	6.2	36.0	6.80	15.49			45.45	1.46																		58490
34	27-Oct-85	500	50	6.2	38.0	6.80	16.91			45.45	1.46																		58490
35	28-Oct-85	0	0	6.2	35.0	6.75	13.65	12.0			0.00	7790	7732	2300	3.36	51.0	37.7	4.0	0.5											58490
36	29-Oct-85	0	0	6.2	34.0	6.93					0.00																			58490
37	30-Oct-85	0	0	6.2	35.5	7.10		7.9			0.00									22290		11400		1847	1140	425	22990	3550	2475	69.0	58490
	AVERAGE	204	29	6.2	36.0	6.85	13.07	11.9	0.961	79.55	0.82	7970	8055	2244	3.66	51.0	37.7	4.0	0.5	22290		11400		1847	1140	425	22990	3550	2475	69.0	52756
38	31-Oct-85	0	0	6.1	35.0	7.15					0.00					64.7	29.2	4.2	0.3											58490
39	01-Nov-85	200	20	6.1	35.5	7.35		7.7		113.64	0.59	7981	5700	3848	1.48															58490
40	02-Nov-85	200	20	6.1	38.0	7.33	16.16			113.64	0.59																			58490
41	03-Nov-85	200	20	6.1	37.0	7.30	14.77			113.64	0.59																			58490
42	04-Nov-85	300	30	6.1	36.5	7.43	15.29	11.0		75.76	0.88	8125	4722	4772	0.99	60.9	25.4	3.8	0.0											58490
43	05-Nov-85	300	30	6.2	35.0	7.30	12.50			75.76	0.88																			58490
44	06-Nov-85	300	30	6.1	35.0	7.25	13.26	11.3		75.76	0.88									17560					20940	4925	2825	57.4	58490
	AVERAGE	214	21	6.1	36.0	7.30	14.41	10.0	1.249	104.06	0.63	8013	5215	4310	1.24	62.8	27.8	4.0	0.6	17560					20940	4925	2825	57.4	58490
45	07-Nov-85	300	30	6.2	35.0	7.40	9.92			75.76	0.88																			58490
46	08-Nov-85	300	30	5.2	36.0	7.30	9.45			75.76	0.88	7914	3855	5177	0.74															58490
47	09-Nov-85	400	40	6.2	33.0	7.25	9.71			56.82	1.17																			58490
48	10-Nov-85	400	40	6.2	35.0	7.35				56.82	1.17																			58490
49	11-Nov-85	400	40	6.2	34.0	7.38		21.6		56.82	1.17	7815	3447	5368	0.64	56.5	36.5	2.2	0.3											58490
50	12-Nov-85	400	40	6.2	35.0	7.22				56.82	1.17																			58490
51	13-Nov-85	400	40	5.7	36.0	7.20		24.0		56.82	1.17									15610		4010		1820	1000	410	19320	3450	2375	68.8	58490
	AVERAGE	371	37	6.0	34.9	7.29	9.70	22.8	0.466	61.19	1.09	7865	3651	5273	0.69	56.5	36.5	2.2	0.3	15610		4010		1820	1000	410	19320	3450	2375	68.8	58490
52	14-Nov-85	400	40	6.2	35.0	7.38				56.82	1.17																			58490
53	15-Nov-85	400	40	6.2	34.5	7.25		17.0		56.82	1.11	7492	3862	5318	0.58	52.9	32.1	2.5	0.5											18780
54	16-Nov-85	500	50	6.2	34.0	7.38	19.39			45.45	1.38																			18780
55	17-Nov-85	500	50	6.2	35.0	7.25	18.85			45.45	1.38																			18780
56	18-Nov-85	500	50	4.7	35.0	7.21	21.16	17.8		45.45	1.38	7546	3156	5325	0.59															18760
57	19-Nov-85	500	50	6.1	38.0	7.25	20.54			45.45	1.38																			19470
58	20-Nov-85	500	50	4.1	36.5	7.29	19.69			45.45	1.38									15070					18380	3300				19470
	AVERAGE	471	47	5.7	35.4	7.26	19.77	17.8	0.798	48.21	1.31	7529	3109	5322	0.59	52.9	32.1	2.5	0.5	15070					18380	3300				24650
59	21-Nov-85	500	50	6.2	34.0	7.28	14.81			45.45	1.38					53.6	38.3	1.6	0.3											19470
60	22-Nov-85	500	50	4.5	35.0	7.18		21.2		45.45	1.38	7287	2936	5122	0.57															19470
61	23-Nov-85	500	50	4.5	35.0	7.21				45.45	1.38																			19470
62	24-Nov-85	500	50	4.5	34.5	7.16				45.45	1.38																			19470
63	25-Nov-85	500	50	6.2	34.5	7.20		23.0		45.45	1.38	6760	3069	4501	0.67	46.9	37.1	7.4	1.4											19470
64	26-Nov-85	600	60	6.2	35.0	7.20				37.88	1.66																			19470
65	27-Nov-85	600	60	6.2	35.0	7.10		24.0		37.88	1.66									14030		2940		1829	1000	365	18320	3450	2475	71.7	19470
	AVERAGE	529	53	5.5	34.7	7.19	14.81	22.7	0.529	43.00	1.46	6984	3003	4852	0.62	50.3	37.7	4.5	0.9	14030		2940		1829	1000	365	18320	3450	2475	71.7	19470

TABLE B-2 MONITORING DATA FOR LABORATORY-SCALE REACTOR R2.0 (CONT'D)

								SP BIO RATE							BIOGAS QUALITY					FILTER		FILTER							SUPL
		WWEY	SUPL	WWEY	TEMP	BIO	BIOGASPROD METER	BUBL	a3/kg COD UR	HRT	LOAD RATE	ALK	VA	BA	VA/BA	CH4	CO2	N2	O2	COD	COD	BOD	BOD	TKN	NH3	TP	TS	TSS	VSS	VSS	COD
DAY	DATE	mL	mL	pH	C	pH	L/d	L/d		d	g/d	mg/L	mg/L	mg/L		%	%	%	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	%	mg/L
66	28-Nov-05	600	60	6.2	35.0	7.10				37.80	1.69																			29470
67	29-Nov-05	600	60	5.2	35.5	7.11	24.37	20.0		37.80	1.69	6326	3108	4663	0.70	45.5	47.0	3.4	0.3												29470
68	30-Nov-05	600	60	6.1	35.0	7.15	20.37			37.80	1.69																				29470
69	01-Dec-05	0	0								0.00																				29470
70	02-Dec-05	600	60	6.2	34.0	7.43				37.80	1.69	6282	2142	4681	0.46																29470
71	03-Dec-05	600	60	6.2	35.0	7.11				37.80	1.69					54.6	39.7	1.7	0.2												29470
72	04-Dec-05	600	60	6.2	36.0	7.20	17.54			37.80	1.69									15020						16790	3580	2680	74.3	29470
	AVERAGE	514	51	6.0	35.1	7.18	20.76	20.0	0.764	44.19	1.45	6264	2665	4372	0.62	50.1	43.4	2.6	0.3	15020						16790	3580	2680	74.3	29470
73	05-Dec-05	600	60	5.4	35.5	7.12				37.80	1.69					53.7	42.4	1.2	0.2												29470
74	06-Dec-05	600	60	4.7	35.0	7.10	18.67	23.0		37.80	1.69	5092	2520	4103	0.61																29470
75	07-Dec-05	650	65	4.7	35.0	7.10				34.97	1.83																				29470
76	08-Dec-05	650	65	4.5	35.0	7.10	22.52			34.97	1.83																				29470
77	09-Dec-05	650	65	6.1	35.0	7.03		21.6		34.97	1.83	5569	2543	3764	0.68	51.9	40.5	1.4	0.2												29470
78	10-Dec-05	650	65	6.2	35.5	7.04	22.16			34.97	1.83																				29470
79	11-Dec-05	650	65	6.2	35.5	7.05				34.97	1.79									16100		3510		1771	870	390	17990	3325	2350	70.7	17200
	AVERAGE	636	64	5.4	35.2	7.09	21.12	22.3	0.634	35.75	1.78	5731	2532	3934	0.65	52.8	41.5	1.3	0.2	16100		3510		1771	870	390	17990	3325	2350	70.7	27717
80	12-Dec-05	650	65	6.2	35.0	7.02	17.26			34.97	1.79																				17200
81	13-Dec-05	650	65	6.2	35.0	7.00		23.0		34.97	1.79	5334	2002	3345	0.84																17200
82	14-Dec-05	650	65	6.2	35.0	7.00	20.01			34.97	1.79																				17200
83	15-Dec-05	650	65	6.2	35.0	7.00				34.97	1.79																				17200
84	16-Dec-05	650	65	6.2	35.0	7.02	25.57	26.4		34.97	1.79	5462	2787	2983	0.93																17200
85	17-Dec-05	700	70	6.2	34.5	7.00				32.47	1.93					50.9	39.7	1.6	0.3												17200
86	18-Dec-05	700	70	6.4	34.5	6.95	18.52	22.6		32.47	1.93									16350						18130	4500	2675	59.4	17200
	AVERAGE	664	66	6.2	34.9	7.00	20.34	24.3	0.600	34.21	1.83	5140	2795	3164	0.89	50.9	39.7	1.6	0.3	16350						18130	4500	2675	59.4	17200
87	19-Dec-05	700	70	5.7	36.0	7.00				32.47	1.93																				17750
88	20-Dec-05	700	70	5.9	36.0	6.98	18.01	21.8		32.47	1.93	4701	3079	2515	1.22	51.9	39.8	1.6	0.3												17750
89	21-Dec-05	700	70	6.2	35.0	6.98				32.47	1.93																				17750
90	22-Dec-05	700	70	6.2	35.0	6.95	17.80			32.47	1.93																				17750
91	23-Dec-05	700	70	6.3	35.0	6.94		26.6		32.47	1.93	4453	3065	2277	1.35																17750
92	24-Dec-05	700	70	5.9	35.0	6.94	20.39			32.47	1.93																				16500
93	25-Dec-05	700	70	5.9	35.0					32.47	1.93									17530		5600		1657	735	369	18100	3575	2550	71.3	16500
	AVERAGE	700	70	6.0	35.3	6.97	18.73	24.2	0.538	32.47	1.93	4577	3072	2396	1.29	51.9	39.8	1.6	0.3	17530		5600		1657	735	369	18100	3575	2550	71.3	17393
94	26-Dec-05	700	70	6.2	34.0					32.47	1.93																				16500
95	27-Dec-05	700	70	6.1	35.0	6.00	19.29			32.47	1.93	4292	3175	2030	1.56																16500
96	28-Dec-05	700	70	6.2	35.0	6.90				32.47	1.93																				16500
97	29-Dec-05	600	60	6.2	35.0	6.90	20.83			37.80	1.65																				16500
98	30-Dec-05	600	60	6.3	35.0	6.90		20.9		37.80	1.65	4143	2987	2879	1.48	53.0	38.1	1.7	0.4												16500
99	31-Dec-05	600	60	6.2	35.0	7.03	20.11			37.80	1.65																				16500
100	01-Jan-06	600	60	6.2	35.0	7.05				37.80	1.65									17900						18190	4050	3075	75.9	16500
	AVERAGE	643	64	6.2	34.9	6.94	20.08	20.9	0.634	35.35	1.77	4218	3041	2959	1.48	53.0	38.1	1.7	0.4	17900						18190	4050	3075	75.9	16500

TABLE B-2 MONITORING DATA FOR LABORATORY-SCALE REACTOR 62.0 (CONT'D)

DAY	DATE	PREV wt.	SUPL wt.	PREV pH	TEMP C	DIG pH	BIOGASPROD METER L/d	BUBL L/d	SP BIO RATE gCOD UR	HRT d	LOAD RATE gCOD/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	FILTER COD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
101	02-Jan-86	600	60	6.4	35.0	7.00	22.91			37.80	1.65					53.2	37.6	1.8	0.3										16500
102	03-Jan-86	600	60	6.2	35.5	7.10				37.80	1.65	4131	2282	2511	0.91														16500
103	04-Jan-86	600	60	6.2	35.0	7.15	19.16			37.80	1.65																		16500
104	05-Jan-86	600	60	6.2	35.0	7.15				37.80	1.65																		16500
105	06-Jan-86	600	60	6.3	35.0	7.10	26.50	25.2		37.80	1.65	4081	2337	2422	0.96	53.0	37.0	2.7	0.6										16500
106	07-Jan-86	600	60	6.9	35.0	7.12				37.80	1.65																		16500
107	08-Jan-86	600	60	5.1	35.0	7.19	19.34	22.1		37.80	1.65									17020	3150				18200	4125	3300	80.0	16500
	AVERAGE	600	60	5.9	35.1	7.12	22.60	23.7	0.736	37.80	1.65	4106	2310	2467	0.94	53.5	37.7	2.3	0.5	17020	3150				18200	4125	3300	80.0	16500
108	09-Jan-86	600	60	3.9	35.0	7.15				37.80	1.65					53.1	37.1	1.8	0.4										16500
109	10-Jan-86	600	60	6.2	35.0	7.12	24.30			37.80	1.65	3982	1924	2616	0.74														16500
110	11-Jan-86	650	65	6.2	35.0	7.10				34.97	1.79																		16500
111	12-Jan-86	650	65	6.2	35.0	7.20	21.20			34.97	1.79																		16500
112	13-Jan-86	650	65	6.3	35.0	7.20				34.97	1.79	3957	1705	2747	0.62														16500
113	14-Jan-86	650	65	5.4	32.0	7.05	24.36			34.97	1.79					52.3	36.7	2.6	0.6										16500
114	15-Jan-86	650	65	5.2	34.0	7.04				34.97	1.83									16100					17660	4550	3400	74.7	29040
	AVERAGE	636	64	5.6	34.4	7.13	23.29		0.712	35.75	1.76	3970	1815	2682	0.68	52.7	36.9	2.2	0.5	16100					17660	4550	3400	74.7	18291
115	16-Jan-86	650	65	4.9	36.0	7.15				34.97	1.83																		29040
116	17-Jan-86	650	65	4.4	35.0	7.05	18.59			34.97	1.83	3833	2876	2359	0.80														29040
117	18-Jan-86	650	65	6.1	35.0	7.07				34.97	1.83																		29040
118	19-Jan-86	650	65	6.1	35.5	7.02	21.90			34.97	1.83																		29040
119	20-Jan-86	650	65	6.0	35.0	7.02				34.97	1.83	3783	1739	2548	0.68	53.1	34.4	2.3	0.5										29040
120	21-Jan-86	650	65	6.0	35.0	7.02	20.66			34.97	1.83																		29040
121	22-Jan-86	650	65	6.0	34.0	7.05	20.16			34.97	1.83									16050	2910				16660	6150	5300	86.2	29040
	AVERAGE	650	65	5.6	35.1	7.05	20.35		0.596	34.97	1.83	3808	1908	2454	0.78	53.1	34.4	2.3	0.5	16050	2910				16660	6150	5300	86.2	29040
122	23-Jan-86	650	65	6.4	34.0	6.95				34.97	1.83					52.2	36.2	2.8	0.6										29040
123	24-Jan-86	650	65	6.3	34.5	7.05	20.09			34.97	1.83	3751	1739	2516	0.69														29040
124	25-Jan-86	650	65	6.4	36.0	7.10				34.97	1.83																		29040
125	26-Jan-86	650	65	6.4	33.0	7.10	20.55			34.97	1.83																		29040
126	27-Jan-86	650	65	6.3	34.0	7.00				34.97	1.83	3716	1443	2692	0.54	52.7	36.7	2.4	0.5										29040
127	28-Jan-86	700	70	6.3	35.0	7.06	21.62			32.47	1.97																		29040
128	29-Jan-86	700	70	6.3	35.0	7.00				32.47	1.97									16010					16340	5150	4150	80.6	29040
	AVERAGE	664	66	6.3	34.5	7.06	21.02		0.602	34.21	1.87	3734	1591	2604	0.62	52.5	36.5	2.6	0.6	16010					16340	5150	4150	80.6	29040
129	30-Jan-86	700	70	6.3	35.0	7.10	34.27			32.47	1.97					53.9	35.7	2.4	0.6										29040
130	31-Jan-86	700	70	6.5	35.0	7.07				32.47	1.97	3667	1478	2628	0.56														29040
131	01-Feb-86	700	70	6.2	35.0	7.10	25.80			32.47	1.97																		29040
132	02-Feb-86	700	70	6.2	32.0	7.07				32.47	1.97																		29040
133	03-Feb-86	700	70	6.1	35.0	7.00	36.17			32.47	1.97	3686	1401	2691	0.52	54.6	37.1	0.9	0.2										29040
134	04-Feb-86	700	70	6.2	35.0	7.10				32.47	1.97																		29040
135	05-Feb-86	700	70	6.2	35.0		27.00			32.47	1.97									15400	6010	3050	1550		15900	5250	4350	82.9	29040
	AVERAGE	700	70	6.0	34.6	7.09	31.03		0.832	32.47	1.97	3677	1440	2660	0.54	54.3	36.4	1.7	0.4	15400	6010	3050	1550		15900	5250	4350	82.9	29040

TABLE B-2 MONITORING DATA FOR LABORATORY-SCALE REACTOR #2.0 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	BIO pH	BIOGASPROD METER L/d	SP BIO RATE BUBL L/d	SP BIO RATE m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	FILTER COD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
136	06-Feb-86	700	70	6.2	34.5	7.10				32.47	1.97					55.3	35.4	0.8	0.2										29040
137	07-Feb-86	700	70	6.0	34.0	7.15	26.47			32.47	1.97	3630	1196	2781	0.43														29040
138	08-Feb-86	750	75	6.3	35.0	7.13				30.30	2.11																		29040
139	09-Feb-86	750	75	6.3	35.0	7.10	31.54			30.30	2.11																		29040
140	10-Feb-86	750	75	6.2	34.0	7.20				30.30	2.11	3705	827	3110	0.27	56.5	34.0	1.1	0.2										29040
141	11-Feb-86	750	75	6.2	35.0	7.14	30.01			30.30	2.11																		29040
142	12-Feb-86	750	75	6.4	34.5	7.19				30.30	2.11									14460					15000	5300	4450	87.7	29040
	AVERAGE	736	74	5.9	34.6	7.16	29.34		0.734	30.89	2.07	3660	1012	2950	0.35	55.9	34.7	1.0	0.2	14460					15000	5300	4450	87.7	29040
143	13-Feb-86	750	75	5.7	34.0	7.18	41.54			30.30	2.11					56.0	34.3	1.2	0.3										29040
144	14-Feb-86	750	75	4.9	36.0	7.19				30.30	2.11	3630	565	3229	0.18														29040
145	15-Feb-86	800	80	6.3	35.0	7.14	29.99			28.41	2.25																		29040
146	16-Feb-86	800	80	6.3	35.0	7.10				28.41	2.25																		29040
147	17-Feb-86	800	80	6.3	36.0	7.13	42.15			28.41	2.25	3593	547	3205	0.17	54.7	34.0	0.9	0.2										29040
148	18-Feb-86	800	80		35.0					28.41	2.25																		29040
149	19-Feb-86	800	80		34.0		30.43			28.41	2.25									14490	1750	2060	520		14970	6300	5150	81.7	29040
	AVERAGE	786	79	5.9	35.0	7.16	35.93		0.843	28.93	2.21	3612	556	3217	0.18	55.8	34.2	1.1	0.3	14490	1750	2060	520		14970	6300	5150	81.7	29040
150	20-Feb-86	0	0		34.0	7.17					0.00					55.2	33.8	1.4	0.3										31590
151	21-Feb-86	800	80	6.4	34.0	7.14	2.43			28.41	2.25	3593	563	3236	0.16														31590
152	22-Feb-86	800	80	6.4	34.0	7.18				28.41	2.25																		31590
153	23-Feb-86	800	80	6.4	35.0	7.15	28.66			28.41	2.25																		31590
154	24-Feb-86	800	80	6.2	36.0	7.30				28.41	2.25	3589	544	3123	0.17	55.6	35.3	2.1	0.5										31590
155	25-Feb-86	850	85	6.0	35.0	7.10	30.76			26.74	2.40																		31590
156	26-Feb-86	850	85	6.1	35.0	7.20				26.74	2.40									14570					15390	7650	5150	67.3	31590
	AVERAGE	700	70	6.3	34.7	7.18	20.62		0.541	32.47	1.97	3551	524	3180	0.17	55.4	34.6	1.8	0.4	14570					15390	7650	5150	67.3	31590
157	27-Feb-86	850	85	6.3	34.0	7.22	45.43			26.74	2.40					56.2	33.7	1.4	0.3										31590
158	28-Feb-86	850	85	5.7	35.0	7.21				26.74	2.40	3397	568	2994	0.19														31590
159	01-Mar-86	850	85	6.1	36.0	7.18	29.93			26.74	2.40																		31590
160	02-Mar-86	850	85	6.1	36.0	7.15				26.74	2.40																		31590
161	03-Mar-86	850	85	6.0	35.0	7.17	41.22			26.74	2.40	3397	535	3017	0.18	57.4	34.7	1.1	0.3										31590
162	04-Mar-86	900	90	6.2	35.0	7.16				25.25	2.54																		31590
163	05-Mar-86	900	90	6.3	34.0	7.19	33.42			25.25	2.54									15180	1430	1620	1620		16100	5600	4800	85.7	31590
	AVERAGE	864	86	6.1	35.0	7.18	37.50		0.807	26.30	2.44	3397	552	3006	0.19	56.8	34.2	1.3	0.3	15180	1430	1620	1620		16100	5600	4800	85.7	31590
164	06-Mar-86	900	90	6.3	35.0	7.20				25.25	2.54					56.5	34.3	1.6	0.4										31590
165	07-Mar-86	900	90	6.0	34.0	7.16	34.27			25.25	2.54	3221	550	2831	0.19														31590
166	08-Mar-86	900	90	6.0	35.0	7.17				25.25	2.54																		31590
167	09-Mar-86	900	90	6.0	35.0	7.14	34.38			25.25	2.54																		31590
168	10-Mar-86	900	90	6.3	36.0	7.20				25.25	2.54	3282	527	2820	0.19	56.3	33.2	2.5	0.6										31590
169	11-Mar-86	1000	100	6.0	35.0	7.20	38.07			22.73	2.82																		31590
170	12-Mar-86	1000	100	6.1	35.0	7.15				22.73	2.82									15020					16010	7300	6150	84.2	31590
	AVERAGE	929	93	6.1	35.0	7.17	35.84		0.727	24.48	2.62	3212	539	2830	0.19	56.4	33.8	2.1	0.5	15020					16010	7300	6150	84.2	31590

TABLE B-2 MONITORING DATA FOR LABORATORY-SCALE REACTOR 02.0 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	BIG pH	BIOGASPROD METER L/d	SP BIO RATE BUBL L/d	SP BIO RATE g3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	SOD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
171	13-Mar-86	1000	100	6.1	35.0	7.11	55.47			22.73	2.02					54.5	32.8	1.4	0.3												31590
172	14-Mar-86	1000	100	6.2	36.0	7.10				22.73	2.02	3881	800	2513	0.32																31590
173	15-Mar-86	1000	100	6.2	36.0	7.17	40.31			22.73	2.02																				31590
174	16-Mar-86	1000	100	6.2	35.0	7.15				22.73	2.02																				31590
175	17-Mar-86	1000	100	6.0	35.0	7.12	44.31			22.73	2.02	3872	619	2633	0.24	57.6	33.0	1.5	0.4												31590
176	18-Mar-86	1000	100	6.2	35.5	7.15				22.73	2.02																				31590
177	19-Mar-86	1000	100	5.3	35.0	7.19	40.02			22.73	2.02									16210	1460	4020	420				15290	8350	7350	88.0	31590
	AVERAGE	1000	100	6.0	35.4	7.14	45.03	0.056		22.73	2.02	3877	710	2573	0.28	56.1	32.9	1.5	0.4	16210	1460	4020	420				15290	8350	7350	88.0	31590
178	20-Mar-86	1000	100	6.2	35.0	7.14				22.73	2.02					58.2	33.2	2.0	0.7												31590
179	21-Mar-86	1000	100	6.0	35.0	7.09	35.09			22.73	2.02	3183	699	2687	0.26																31590
180	22-Mar-86	1000	100	6.0	35.0	7.11				22.73	2.02																				31590
181	23-Mar-86	1000	100	6.0	35.0	7.12	36.60			22.73	2.02																				31590
182	24-Mar-86	1000	100	6.0	36.0	7.11				22.73	2.02	3146	443	2832	0.16	60.0	33.0	2.1	0.5												31590
183	25-Mar-86	1000	100	6.2	35.0	7.13	33.87			22.73	2.02																				31590
184	26-Mar-86	1000	100	6.2	35.0	7.11				22.73	2.02									15740							15340	7450	6950	93.3	31590
	AVERAGE	1000	100	6.1	35.1	7.12	35.19	0.662		22.73	2.02	3165	571	2760	0.21	59.5	33.5	2.5	0.6	15740							15340	7450	6950	93.3	31590
185	27-Mar-86	1000	100	6.2	35.0	7.13	47.91			22.73	2.02					58.7	34.0	1.7	0.4												31590
186	28-Mar-86	1000	100	6.2	35.0					22.73	2.02																				31590
187	29-Mar-86	1000	100	6.2	35.0					22.73	2.02																				31590
188	30-Mar-86	1000	100	6.2	35.0					22.73	2.02																				31590
189	31-Mar-86	1000	100	6.2	35.0					22.73	2.02																				31590
190	01-Apr-86	1000	100	6.1	35.0					22.73	2.02																				31590
191	02-Apr-86	1000	100	6.1	35.0					22.73	2.02																				31590
	AVERAGE	1000	100	6.2	35.0	7.13	47.91			22.73	2.02					58.7	34.0	1.7	0.4												
192	03-Apr-86	1100	110		35.0	7.08				20.66	3.09				0.02					15220											30140
193	04-Apr-86	1100	110		35.0					20.66	3.09																				30140
194	05-Apr-86	1100	110		35.0					20.66	3.09																				30140
195	06-Apr-86	1100	110		35.0					20.66	3.09																				30140
196	07-Apr-86	1100	110		35.0					20.66	3.09																				30140
197	08-Apr-86	1100	110		35.0					20.66	3.09																				30140
198	09-Apr-86	1100	110		35.0					20.66	3.09																				30140
	AVERAGE	1100	110		35.0	7.08				20.66	3.09				0.02					15220											
199	10-Apr-86	1100	110		35.0					20.66	3.09	3165	650	2784	0.24					16080											30140
200	11-Apr-86	1100	110		35.0					20.66	3.09																				30140
201	12-Apr-86	1100	110		35.0					20.66	3.09																				30140
202	13-Apr-86	1100	110		35.0					20.66	3.09																				30140
203	14-Apr-86	1100	110		35.0					20.66	3.09																				30140
204	15-Apr-86	1100	110		35.0					20.66	3.09																				30140
205	16-Apr-86	1100	110		35.0					20.66	3.09																				30140
	AVERAGE	1100	110		35.0					20.66	3.09	3165	650	2784	0.24					16080											

TABLE B-2 MONITORING DATA FOR LABORATORY-SCALE REACTOR 62.0 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	DIG pH	BIOGASPROD METER L/d	SP BIO RATE BIOGL L/d	m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	H2 %	O2 %	COD mg/L	FILTER COD mg/L	BOD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
206	17-Apr-86	1100	110		35.0					20.66	3.09	3239	899	2681	0.35					16150											30140
207	18-Apr-86	1100	110		35.0					20.66	3.09																				30140
208	19-Apr-86	1100	110		35.0					20.66	3.09																				30140
209	20-Apr-86	1100	110		35.0					20.66	3.09																				30140
210	21-Apr-86	1100	110		35.0					20.66	3.09																				30140
211	22-Apr-86	1100	110		35.0					20.66	3.09																				30140
212	23-Apr-86	1100	110		35.0					20.66	3.09																				30140
	AVERAGE	1100	110		35.0					20.66	3.09	3239	899	2681	0.35					16150											30140
213	24-Apr-86	1100	110		35.0					20.66	3.09	3165	193	3028	0.06					15570											30140
214	25-Apr-86	1200	120		35.0					18.94	3.38																				30140
215	26-Apr-86	1200	120		35.0					18.94	3.38																				30140
216	27-Apr-86	1200	120		35.0					18.94	3.38																				30140
217	28-Apr-86	1200	120		35.0					18.94	3.38																				30140
218	29-Apr-86	1200	120		35.0					18.94	3.38																				30140
219	30-Apr-86	1200	120		35.0					18.94	3.38																				30140
	AVERAGE	1186	119		35.0					19.19	3.33	3165	193	3028	0.06					15570											30140
220	01-May-86	1200	120		35.0	7.10				18.94	3.38	2951	172	2829	0.06					15700											30140
221	02-May-86	1200	120		35.0					18.94	3.38																				30140
222	03-May-86	1200	120		35.0					18.94	3.38																				30140
223	04-May-86	1200	120		35.0					18.94	3.38																				30140
224	05-May-86	1200	120		35.0					18.94	3.38																				30140
225	06-May-86	1200	120		35.0					18.94	3.38																				30140
226	07-May-86	1200	120		35.0					18.94	3.38																				30140
	AVERAGE	1200	120		35.0	7.10				18.94	3.38	2951	172	2829	0.06					15700											30140
227	08-May-86	1200	120		35.0	6.99				18.94	3.38	2699	230	2536	0.09					15670											30140
228	09-May-86	1200	120		35.0					18.94	3.38																				30140
229	10-May-86	1200	120		35.0					18.94	3.38																				30140
230	11-May-86	1200	120		35.0					18.94	3.38																				30140
231	12-May-86	1200	120		35.0					18.94	3.38																				30140
232	13-May-86	1200	120		35.0					18.94	3.38																				30140
233	14-May-86	1200	120		35.0					18.94	3.38																				30140
	AVERAGE	1200	120		35.0	6.99				18.94	3.38	2699	230	2536	0.09					15670											30140
234	15-May-86	1200	120		35.0	7.15				18.94	3.38	2662	232	2497	0.09					17473											30140
235	16-May-86	1200	120		35.0					18.94	3.38																				30140
236	17-May-86	1200	120		35.0					18.94	3.38																				30140
237	18-May-86	1200	120		35.0					18.94	3.38																				30140
238	19-May-86	1200	120		35.0					18.94	3.38																				30140
239	20-May-86	1200	120		35.0					18.94	3.38																				30140
240	21-May-86	1200	120		35.0					18.94	3.38																				30140
	AVERAGE	1200	120		35.0	7.15				18.94	3.38	2662	232	2497	0.09					17473											30140

TABLE B-2 MONITORING DATA FOR LABORATORY-SCALE REACTOR 02.0 (CONT'D)

DAY	DATE	WHEY	SUPL	WHEY	TEMP	DIG	BIOGASPROD METER	BUBL	SP BIO RATE	HRT	LOAD RATE	ALK	VA	BA	VA/BA	BIOGAS QUALITY CH4	CO2	N2	O2	COD	FILTER COD	BOD	FILTER BOD	TKN	NH3	TP	TS	TBS	VBS	VSS	SUPL COD
		mL	mL	pH	C	pH	L/d	L/d	m3/kg COD	Ut	d	g/d	mg/L	mg/L	mg/L		%	%	%	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	%	mg/L
241	22-May-86	1200	120		35.0	7.10				10.94	3.38	2988	189	2854	0.07					10164										30140
242	23-May-86	1200	120		35.0					10.94	3.38																			30140
243	24-May-86	1200	120		35.0					10.94	3.38																			30140
244	25-May-86	1200	120		35.0					10.94	3.38																			30140
245	26-May-86	1200	120		35.0					10.94	3.38																			30140
246	27-May-86	1200	120		35.0					10.94	3.38																			30140
247	28-May-86	1200	120		35.0					10.94	3.38																			30140
																														30140
	AVERAGE	1200	120		35.0	7.10				10.94	3.38	2988	189	2854	0.07					10164										30140
248	29-May-86	1200	0		35.0	7.20				20.83	3.23	3872	200	3676	0.08					17447										
249	30-May-86	1200	0		35.0					20.83	3.23																			30140
250	31-May-86	1200	0		35.0					20.83	3.23																			30140
251	01-Jun-86	0	0		35.0						0.00																			30140
252	02-Jun-86	1200	0		35.0					20.83	3.23																			30140
253	03-Jun-86	1200	0		35.0					20.83	3.23																			30140
254	04-Jun-86	1200	720		35.0					13.02	4.10																			30140
																														30140
	AVERAGE	1029	103		35.0	7.20				19.53	2.89	3872	200	3676	0.08					17447										30140
255	05-Jun-86	1200	0		35.0					20.83	3.23	4123	1005	3353	0.32															
256	06-Jun-86	1200	0		35.0					20.83	3.23																			30140
257	07-Jun-86	1200	0		35.0					20.83	3.23																			30140
258	08-Jun-86	0	0		35.0						0.00																			30140
259	09-Jun-86	1200	0		35.0					20.83	3.23																			30140
260	10-Jun-86	1200	0		35.0					20.83	3.23																			30140
261	11-Jun-86	1200	720		35.0					13.02	4.10																			30140
																														30140
	AVERAGE	1029	103		35.0					19.53	2.89	4123	1005	3353	0.32															30140
262	12-Jun-86	1200	0		35.0					20.83	3.23	3881	1504	2756	0.57					13132										
263	13-Jun-86	1200	0		35.0					20.83	3.23																			30140
264	14-Jun-86	1200	0		35.0					20.83	3.23																			30140
265	15-Jun-86	0	0		35.0						0.00																			30140
266	16-Jun-86	1200	0		35.0					20.83	3.23																			30140
267	17-Jun-86	1200	0		35.0					20.83	3.23																			30140
268	18-Jun-86	1200	720		35.0					13.02	4.10																			30140
																														30140
	AVERAGE	1029	103		35.0					19.53	2.89	3881	1504	2756	0.57					13132										30140
269	19-Jun-86	1200	0		35.0					20.83	3.23	3723	1883	2386	0.79					14738										
270	20-Jun-86	1200	0		35.0					20.83	3.23																			30140
271	21-Jun-86	1200	0		35.0					20.83	3.23																			30140
272	22-Jun-86	0	0		35.0						0.00																			30140
273	23-Jun-86	1200	0		35.0					20.83	3.23																			30140
274	24-Jun-86	1200	0		35.0					20.83	3.23																			30140
275	25-Jun-86	1200	0		35.0					20.83	3.23																			30140
																														30140
	AVERAGE	1029	0		35.0					20.83	2.77	3723	1883	2386	0.79					14738										30140

TABLE B-2 MONITORING DATA FOR LABORATORY-SCALE REACTOR 02.0 (CONT'D)

DAY	DATE	WWEY mL	SUPL mL	WWEY pH	TEMP C	BIO pH	SP BIO DIOGASPROD METER L/d	SP BIO DIOGASPROD RATE BUBL L/d	SP BIO RATE mJ/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TDS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
241	22-May-86	1200	120		35.0	7.10				10.94	3.38	2900	109	2054	0.07					10164										30140
242	23-May-86	1200	120		35.0					10.94	3.38																			30140
243	24-May-86	1200	120		35.0					10.94	3.38																			30140
244	25-May-86	1200	120		35.0					10.94	3.38																			30140
245	26-May-86	1200	120		35.0					10.94	3.38																			30140
246	27-May-86	1200	120		35.0					10.94	3.38																			30140
247	28-May-86	1200	120		35.0					10.94	3.38																			30140
	AVERAGE	1200	120		35.0	7.10				10.94	3.38	2900	109	2054	0.07					10164										30140
248	29-May-86	1200	0		35.0	7.20				20.83	3.23	3872	280	3476	0.08					17447										30140
249	30-May-86	1200	0		35.0					20.83	3.23																			30140
250	31-May-86	1200	0		35.0					20.83	3.23																			30140
251	01-Jun-86	0	0		35.0						0.00																			30140
252	02-Jun-86	1200	0		35.0					20.83	3.23																			30140
253	03-Jun-86	1200	0		35.0					20.83	3.23																			30140
254	04-Jun-86	1200	720		35.0					13.02	4.16																			30140
	AVERAGE	1029	103		35.0	7.20				19.53	2.89	3872	280	3476	0.08					17447										30140
255	05-Jun-86	1200	0		35.0					20.83	3.23	4123	1085	3353	0.32															30140
256	06-Jun-86	1200	0		35.0					20.83	3.23																			30140
257	07-Jun-86	1200	0		35.0					20.83	3.23																			30140
258	08-Jun-86	0	0		35.0						0.00																			30140
259	09-Jun-86	1200	0		35.0					20.83	3.23																			30140
260	10-Jun-86	1200	0		35.0					20.83	3.23																			30140
261	11-Jun-86	1200	720		35.0					13.02	4.16																			30140
	AVERAGE	1029	103		35.0					19.53	2.89	4123	1085	3353	0.32															30140
262	12-Jun-86	1200	0		35.0					20.83	3.23	3881	1504	2736	0.57					13132										30140
263	13-Jun-86	1200	0		35.0					20.83	3.23																			30140
264	14-Jun-86	1200	0		35.0					20.83	3.23																			30140
265	15-Jun-86	0	0		35.0						0.00																			30140
266	16-Jun-86	1200	0		35.0					20.83	3.23																			30140
267	17-Jun-86	1200	0		35.0					20.83	3.23																			30140
268	18-Jun-86	1200	720		35.0					13.02	4.16																			30140
	AVERAGE	1029	103		35.0					19.53	2.89	3881	1504	2736	0.57					13132										30140
269	19-Jun-86	1200	0		35.0					20.83	3.23	3723	1883	2386	0.79					14738										30140
270	20-Jun-86	1200	0		35.0					20.83	3.23																			30140
271	21-Jun-86	1200	0		35.0					20.83	3.23																			30140
272	22-Jun-86	0	0		35.0						0.00																			30140
273	23-Jun-86	1200	0		35.0					20.83	3.23																			30140
274	24-Jun-86	1200	0		35.0					20.83	3.23																			30140
275	25-Jun-86	1200	0		35.0					20.83	3.23																			30140
	AVERAGE	1029	0		35.0					20.83	2.77	3723	1883	2386	0.79					14738										30140

TABLE B-2 MONITORING DATA FOR LABORATORY-SCALE REACTOR #2.0 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	BIO pH	BIOGASPROD METER L/d	BIOGASPROD BUBL L/d	SP BIO RATE m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	FILTER COD COD mg/L	FILTER COD COD mg/L	FILTER BOD BOD mg/L	FILTER BOD BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD COD mg/L
276	26-Jun-86	1200	0	35.0						20.83	3.23	3034	343	2862	0.00					14980											30140
277	27-Jun-86																														
278	28-Jun-86																														
279	29-Jun-86																														
280	30-Jun-86																														
281	01-Jul-86																														
282	02-Jul-86																														
	AVERAGE	1200	0	35.0		41.00		0.653	20.83	3.23	3034	343	2862	0.00						14980											30140

TABLE B-3 MONITORING DATA FOR LABORATORY-SCALE REACTOR #3.0

DAY	DATE	INFV gL	INFL gL	INFV pH	TEMP C	DIG pH	BIOGASPROD METER L/d	BIOGAS L/d	BP BIO RATE g3/kg COD UR	HRT d	LOAD RATE g/d	ALK eq/L	VA eq/L	BA eq/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	H2 %	O2 %	FILTER COD eq/L	FILTER BOD eq/L	FILTER DOC eq/L	TKN eq/L	NH3 eq/L	TP eq/L	TS eq/L	TSS eq/L	VSS eq/L	VSS %	EMPL COD eq/L
	19-Sep-85																													
	20-Sep-85																													
	21-Sep-85																													
	22-Sep-85																													
	23-Sep-85																													10350
1	24-Sep-85	400	0	6.2	32.5	7.35				62.50	1.00																			10350
2	25-Sep-85	400	0	6.2	33.0	7.40				62.50	1.00	10830	4305	7717	0.57															
	AVERAGE	400	0	6.2	33.0	7.40				62.50	1.00	10830	4305	7717	0.57															10350
																														10350
3	26-Sep-85	400	0	3.4	37.0	7.29				62.50	1.00																			10350
4	27-Sep-85	400	0	3.5	36.5	7.30	10.29	16.9		62.50	1.00																			10350
5	28-Sep-85	0	0								0.00																			10350
6	29-Sep-85	0	0								0.00																			10350
7	30-Sep-85	400	200	6.1	35.5	7.22	10.38	13.7		41.67	1.22	10611	5904	6419	0.92															10350
8	01-Oct-85	400	0	4.2	34.0	7.21	10.29			62.50	1.00																			10350
9	02-Oct-85	400	0	3.4	33.5	7.23	8.51	12.2		62.50	1.00									17340	10640		1780	1260	225					
	AVERAGE	286	29	4.1	35.3	7.25	11.07	13.6	0.96	58.33	0.79	10611	5904	6419	0.92					17340	10640		1780	1260	225					10350
																														10350
10	03-Oct-85	400	0	3.4	35.0	7.08	10.82			62.50	1.00					36.6	48.5	4.1	0.3											10350
11	04-Oct-85	400	0	6.3	36.5	7.10	10.62	13.2		62.50	1.00	10447	8061	4643	1.74															10350
12	05-Oct-85	0	0								0.00																			10350
13	06-Oct-85	0	0								0.00																			10350
14	07-Oct-85	400	0	6.1	34.5	7.10	13.23	9.1		62.50	1.00	9694	7539	4266	1.77															10350
15	08-Oct-85	400	0	6.1	36.5	7.05	7.72			62.50	1.00																			10350
16	09-Oct-85	400	0	6.1	36.5	7.00				62.50	1.00									10640										
	AVERAGE	286	0	5.6	35.8	7.07	10.59	11.2	0.90	62.50	0.77	10071	7800	4455	1.75	36.6	48.5	4.1	0.3	10640										10350
																														10350
17	10-Oct-85	400	0	4.3	35.0	7.00	8.51			62.50	1.00																			10350
18	11-Oct-85	400	200	4.3	36.0	6.92	9.35	13.9		41.67	1.22	9543	8210	3632	2.26															10350
19	12-Oct-85	0	0								0.00																			10350
20	13-Oct-85	0	0								0.00																			10350
21	14-Oct-85	500	0	4.3						50.00	1.35																			10350
22	15-Oct-85	500	25	3.0	37.0	7.04				47.62	1.36	9079	8000	3261	2.48	49.0	40.7	0.9	0.2											10350
23	16-Oct-85	300	25	3.0	35.5	7.01		13.2		47.62	1.36									10200	10740		1760	1127	260	21000	2875	2130	74.0	10350
	AVERAGE	329	36	4.1	35.9	6.99	8.93	13.6	0.65	49.08	0.91	9311	8105	3447	2.37	49.0	40.7	0.9	0.2	10200	10740		1760	1127	260	21000	2875	2130	74.0	10350
																														10350
24	17-Oct-85	500	25	4.4	36.0	6.80				47.62	1.36																			10350
25	18-Oct-85	500	25	5.0	37.0	6.85		13.7		47.62	1.36	8664	7939	2940	2.69	45.0	44.3	2.3	0.3											10350
26	19-Oct-85	500	25	5.0		6.79	13.42			47.62	1.36																			10350
27	20-Oct-85	500	25	5.0		6.72	13.52			47.62	1.36																			10350
28	21-Oct-85	500	25	6.2	32.5	6.70	10.50	15.0		47.62	1.36	8621	8747	2323	3.77															10350
29	22-Oct-85	500	200	3.6	38.0	6.65				35.71	1.49					45.6	45.2	2.5	0.2											
30	23-Oct-85	500	200	5.9	37.0	6.65		10.5		35.71	1.49									21670						21990	1625	1150	70.0	10350
	AVERAGE	500	75	5.0	36.1	6.74	12.48	16.0	0.35	44.22	1.40	8643	8343	2636	3.23	44.7	43.8	2.4	0.3	21670						21990	1625	1150	70.0	10350

TABLE B-3 MONITORING DATA FOR LABORATORY-SCALE REACTOR 63.0 (CONT'D)

DAY	DATE	WWEY	SUPL	WWEY	TEMP	DIG	BIOGAS PROD METER	BUBL	SP BIO RATE gVS/kg COD UR	HRT	LOAD RATE	ALK	VA	BA	VA/BA	BIOGAS QUALITY CH4	CO2	N2	O2	COD	FILTER COD	FILTER BOD	BOD	TKN	NH3	TP	TS	TSS	VSS	VSS	SUPL COD
		mL	mL	pH	C	pH	L/d	L/d		d	g/d	eq/L	eq/L	eq/L		%	%	%	%	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	%	eq/L
31	24-Oct-85	500	25	6.2	38.0	6.75	17.43			47.62	1.40																				
32	25-Oct-85	500	25	6.1	35.5	6.70	15.12	17.0		47.62	1.40	6847	8339	843	9.89																58490
33	26-Oct-85	500	25	6.2	36.0	6.60	12.71			47.62	1.40																				58490
34	27-Oct-85	500	25	6.2	38.0	6.60	14.49			47.62	1.40																				58490
35	28-Oct-85	0	0	6.2	35.0	6.60	12.44	9.8		0.00		7715	8043	2695	4.81	49.7	38.3	2.9	0.4												58490
36	29-Oct-85	0	0	6.2	34.0	6.60	7.72			0.00																					58490
37	30-Oct-85	0	0	6.2	35.5	7.00		0.6		0.00										23340		11490		1707	1107	329	20900	2050	2150	75.4	58490
	AVERAGE	206	14	6.2	36.0	6.72	13.32	11.8	1.71	47.62	0.80	7281	8191	1424	6.95	49.7	38.3	2.9	0.4	23340		11490		1707	1107	329	20900	2050	2150	75.4	58490
38	31-Oct-85	0	0	6.1	35.0	7.05				0.00						62.0	20.9	6.9	0.4												58490
39	01-Nov-85	200	10	6.1	35.5	7.20		8.2		119.05	0.56	7566	6435	2997	2.15																58490
40	02-Nov-85	200	10	6.1	38.0	7.20				119.05	0.56																				58490
41	03-Nov-85	200	10	6.1	37.0	7.20				119.05	0.56																				58490
42	04-Nov-85	300	15	6.1	36.5	7.30		12.0		79.37	0.84	8001	5671	3975	1.43	61.4	27.8	2.0	0.3												58490
43	05-Nov-85	300	15	6.2	35.0	7.20	14.57			79.37	0.84																				58490
44	06-Nov-85	300	15	6.1	35.0	7.13	14.92			79.37	0.84									18290							20350	3575	2350	71.3	58490
	AVERAGE	214	11	6.1	36.0	7.18	14.74	10.1	1.41	99.21	0.68	7784	6053	3486	1.79	62.1	24.4	3.5	0.4	18290							20350	3575	2350	71.3	58490
45	07-Nov-85	300	15	6.2	35.0	7.15	13.62			79.37	0.84																				
46	08-Nov-85	300	15	5.2	36.0	7.10	12.38			79.37	0.84	7963	5026	4395	1.14																58490
47	09-Nov-85	300	15	6.2	33.0	7.10	11.75			79.37	0.84																				58490
48	10-Nov-85	300	15	6.2	35.0	7.27	11.81			79.37	0.84																				58490
49	11-Nov-85	300	15	6.2	34.0	7.25	10.45			79.37	0.84	7877	4485	4693	0.96	55.1	34.0	3.5	0.6												58490
50	12-Nov-85	400	20	6.2	35.0	7.17				59.52	1.12																				58490
51	13-Nov-85	400	20	5.7	36.0	7.15		10.2		59.52	1.12									16500		4790		1750	1040	372	19490	2275	1650	72.5	58490
	AVERAGE	329	16	6.0	34.9	7.18	12.00	10.2	0.69	73.70	0.92	7920	4756	4544	1.05	55.1	34.0	3.5	0.6	16500		4790		1750	1040	372	19490	2275	1650	72.5	58490
52	14-Nov-85	400	20	6.2	35.0	7.20				59.52	1.12																				
53	15-Nov-85	400	20	6.2	34.5	7.15		17.0		59.52	1.09	7691	4225	4491	0.90	52.1	33.7	2.7	0.6												58490
54	16-Nov-85	500	25	6.2	34.0	7.23				47.62	1.36																				18780
55	17-Nov-85	500	25	6.2	35.0	7.18				47.62	1.36																				18780
56	18-Nov-85	500	25	6.7	35.0	7.11	19.39	17.3		47.62	1.36	7554	4203	4512	0.93																18780
57	19-Nov-85	500	25	6.1	38.0	7.15	19.63			47.62	1.37																				18780
58	20-Nov-85	500	25	6.1	36.5	7.20	20.33			47.62	1.37																				19470
	AVERAGE	471	24	5.7	35.4	7.17	19.79	17.5	0.81	51.02	1.29	7623	4235	4602	0.93	52.1	33.7	2.7	0.6	15890							18940	700			19470
59	21-Nov-85	500	25	6.2	36.0	7.20	16.54			47.62	1.37																				24450
60	22-Nov-85	500	25	6.5	35.0	7.10	16.23	19.2		47.62	1.37	7870	3877	4317	0.89	53.6	37.6	1.6	0.2												19470
61	23-Nov-85	500	25	6.5	35.0	7.14	16.78			47.62	1.37																				19470
62	24-Nov-85	500	25	6.5	34.5	7.00	14.44			47.62	1.37																				19470
63	25-Nov-85	500	25	6.2	34.5	7.07		19.2		47.62	1.37	6723	4025	3865	1.04																19470
64	26-Nov-85	600	30	6.2	35.0	7.07				39.68	1.64																				19470
65	27-Nov-85	600	30	6.2	35.0	7.00		19.7		39.68	1.64									16100		4040		1771	950	313	18910	2200	1750	79.5	19470
	AVERAGE	529	26	5.5	34.7	7.09	15.97	19.4	0.59	45.35	1.44	6897	3951	4091	0.97	53.6	37.6	1.6	0.2	16100		4040		1771	950	313	18910	2200	1750	79.5	19470

TABLE B-3 MONITORING DATA FOR LABORATORY-SCALE REACTOR #3.0 (CONT'D)

DAY	DATE	WWEY mL	SUPL mL	INFV pH	TEMP C	DIG pH	BIOGAS METER L/d	BIOGAS PROD BUBL L/d	SP BIO GAS RATE m3/kg COD	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	FILTER COD COD mg/L	FILTER BOD BOD mg/L	FILTER BOD BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
66	28-Nov-85	600	30	6.2	35.0	6.95				39.68	1.62																			
67	29-Nov-85	600	30	5.2	35.5	7.00		19.2		39.68	1.62	6202	4203	3210	1.31	51.8	43.5	1.5	0.3											
68	30-Nov-85	600	30	6.1	35.0	7.01	17.22			39.68	1.62																			
69	01-Dec-85	0	0								0.00																			
70	02-Dec-85	600	30	6.2	34.0	7.22				39.68	1.62	6078	3425	3646	0.94															
71	03-Dec-85	600	30	6.2	35.0	7.00				39.68	1.62					52.6	39.5	2.4	6.2											
72	04-Dec-85	600	30	6.2	36.0	7.03	17.98	23.0		39.68	1.62									16740					16920	2325	1675	72.0		
	AVERAGE	514	26	6.0	35.1	7.04	17.56	21.5	0.73	39.68	1.38	6140	3814	3432	1.13	52.2	41.5	2.0	0.3	16740					16920	2325	1675	72.0		
73	05-Dec-85	600	30	5.4	35.5	6.95				39.68	1.62					52.8	43.0	2.3	0.2											
74	06-Dec-85	600	30	4.7	35.0	6.95	19.27	20.6		39.68	1.62	5805	3870	3057	1.27															
75	07-Dec-85	650	33	4.5	35.0	6.95				36.63	1.75																			
76	08-Dec-85	650	33	4.5	35.0	6.98	22.10			36.63	1.75																			
77	09-Dec-85	650	33	6.1	35.0	6.83		20.6		36.63	1.75	5235	4033	2372	1.70															
78	10-Dec-85	650	33	6.2	35.5	6.80	24.20			36.63	1.75					49.2	39.8	2.1	0.4											
79	11-Dec-85	650	33	6.2	35.5	6.80				36.63	1.77									17360		5960		1714	830	329	18310	2650	2050	77.4	17200
	AVERAGE	636	32	5.4	35.2	6.88	21.86	20.6	0.70	37.50	1.71	5520	3952	2715	1.49	50.6	41.4	2.2	0.3	17360		5960		1714	830	329	18310	2650	2050	77.4	17200
80	12-Dec-85	650	33	6.2	35.0	6.78	23.31			36.63	1.77																			17200
81	13-Dec-85	650	33	6.2	35.0	6.75		21.8		36.63	1.77	5048	4240	2032	2.10															17200
82	14-Dec-85	650	33	6.2	35.0	6.80	21.99			36.63	1.77																			17200
83	15-Dec-85	600	30	6.2	35.0	6.67				39.68	1.64																			17200
84	16-Dec-85	600	30	6.2	35.0	6.71	21.43	19.4		39.68	1.64	4639	4337	1560	2.78	47.4	46.4	2.1	0.4											17200
85	17-Dec-85	400	20	6.2	34.5	6.70				59.52	1.09																			17200
86	18-Dec-85	400	20	6.4	34.5	6.70	15.49	12.5		59.52	1.09									18660					16670	1975	1300	65.8	17200
	AVERAGE	564	28	6.2	34.9	6.73	20.56	17.9	0.74	44.84	1.54	4844	4293	1796	2.44	47.4	46.4	2.1	0.4	18660					16670	1975	1300	65.8	17200	
87	19-Dec-85	400	20	5.7	36.0	6.76				59.52	1.09																			17750
88	20-Dec-85	400	20	5.7	36.0	6.78	15.33	14.6		59.52	1.09	4714	4212	1724	2.44	50.8	39.5	2.7	0.5											17750
89	21-Dec-85	400	20	6.2	35.0	6.78				59.52	1.09																			17750
90	22-Dec-85	400	20	6.2	35.0	6.78	14.54			59.52	1.09																			17750
91	23-Dec-85	400	20	6.3	35.0	6.80		14.2		59.52	1.09	4652	4316	1388	2.72															17750
92	24-Dec-85	400	20	5.9	35.0	6.79	15.08			59.52	1.09																			16500
93	25-Dec-85	400	20	5.9	35.0					59.52	1.09									18480		6790		1571	735	388	17790	2575	2050	79.6	16500
	AVERAGE	400	20	6.0	35.3	6.78	15.23	14.4	0.78	59.52	1.09	4683	4264	1656	2.58	50.8	39.5	2.7	0.5	18480		6790		1571	735	388	17790	2575	2050	79.6	17393
94	26-Dec-85	400	20	6.2	34.0					59.52	1.09																			16500
95	27-Dec-85	400	20	6.1	35.0	6.78	17.33			59.52	1.09	4515	3533	2007	1.76															16500
96	28-Dec-85	400	20	6.2	35.0	6.83				59.52	1.09																			16500
97	29-Dec-85	400	20	6.2	35.0	6.85	13.97			59.52	1.09																			16500
98	30-Dec-85	400	20	6.3	35.0	6.83		12.5		59.52	1.09	4441	3540	1938	1.81	51.4	37.8	2.4	0.4											16500
99	31-Dec-85	400	20	6.2	35.0	6.98	13.81			59.52	1.09																			16500
100	01-Jan-86	400	20	6.2	35.0	6.98				59.52	1.09									17720					17550	2000	2225	79.5	16500	
	AVERAGE	400	20	6.2	34.9	6.88	15.03	12.5	0.76	59.52	1.09	4478	3537	1983	1.79	51.4	37.8	2.4	0.4	17720					17550	2000	2225	79.5	16500	

TABLE B-3 MONITORING DATA FOR LABORATORY-SCALE REACTOR 83.0 (CONT'D)

DAY	DATE	WWEY mL	SUPL mL	WWEY pH	TEMP C	DIG pH	BIOGASPROD METER L/d	SP DIG RATE BUDL L/d	SP DIG RATE gal/kg COD Rt	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	H2 %	O2 %	COD mg/L	FILTER COD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
101	02-Jan-86	400	20	6.4	35.0	6.90	12.54			59.52	1.09					51.5	38.3	2.0	0.5											16500
102	03-Jan-86	400	20	6.2	35.5	7.02				59.52	1.09	4453	3223	2165	1.49															16500
103	04-Jan-86	400	20	6.2	35.0	7.07	12.60			59.52	1.09																			16500
104	05-Jan-86	400	20	6.2	35.0	7.13				59.52	1.09																			16500
105	06-Jan-86	400	20	6.3	35.0	7.03	13.61			59.52	1.09	4465	3052	2298	1.33	49.7	36.4	4.9	1.0											16500
106	07-Jan-86	400	20	4.9	35.0	7.05				59.52	1.09																			16500
107	08-Jan-86	400	20	5.1	35.0	7.10	15.20			59.52	1.09									16720		4120				17320	2425	1900	78.4	16500
	AVERAGE	400	20	5.9	35.1	7.05	13.51		0.67	59.52	1.09	4459	3138	2232	1.41	50.6	37.4	3.9	0.8	16720		4120				17320	2425	1900	78.4	16500
108	09-Jan-86	400	20	3.9	35.0	7.05				59.52	1.09					49.8	37.5	3.0	0.6											16500
109	10-Jan-86	400	20	6.2	35.0	7.02	19.16			59.52	1.09	4391	2935	2293	1.29															16500
110	11-Jan-86	400	20	6.2	35.0	7.08				59.52	1.09																			16500
111	12-Jan-86	400	20	6.2	35.0	7.12	14.38			59.52	1.09																			16500
112	13-Jan-86	400	20	6.3	35.0	7.12				59.52	1.09	4465	2811	2469	1.14					15750						16820	3350	2250	67.2	16500
113	14-Jan-86																													
114	15-Jan-86																													
	AVERAGE	400	20	5.8	35.0	7.08	16.74		0.81	59.52	1.09	4428	2883	2381	1.22	49.8	37.5	3.0	0.6	15750						16820	3350	2250	67.2	16500

TABLE B-4 MONITORING DATA FOR LABORATORY-SCALE REACTOR 83.1 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	DIG pH	BIOGAS METER L/d	BIOGAS PROD BUBL L/d	SP BIO RATE m3/kg COD UR	HRT d	LOAD RATE g/d	ALK eq/L	VA eq/L	BA eq/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	H2 %	O2 %	FILTER COD COD eq/L	FILTER COD eq/L	BOD eq/L	BOD eq/L	TKN eq/L	NH3 eq/L	TP eq/L	TS eq/L	TSS eq/L	VSS eq/L	VSS %	SUPL COD eq/L
30	20-Feb-86	0	0		34.0	6.90					0.00					50.6	35.4	3.3	0.7												1600
31	21-Feb-86	500	75	6.4	34.0	7.20	0.06			43.48	1.35	3625	500	2670	0.19																1600
32	22-Feb-86	500	75	6.4	34.0	7.02				43.48	1.35																				1600
33	23-Feb-86	500	75	6.4	35.0	7.00	14.92			43.48	1.35																				1600
34	24-Feb-86	500	75	6.2	36.0	6.91				43.48	1.35	2932	900	2231	0.32	48.4	38.4	3.9	0.8												1600
35	25-Feb-86	500	75	6.0	35.0	6.90	16.45			43.48	1.35																				1600
36	26-Feb-86	500	75	6.1	35.0	6.94				43.48	1.35									4090							5600	3425	2375	69.3	2160
	AVERAGE	429	64	6.3	34.7	6.99	13.14	0.503	43.48	1.16	2979	744	2451	0.26	49.5	36.9	3.6	0.8	4090							5600	3425	2375	69.3	1680
37	27-Feb-86	500	75	6.3	34.0	6.93	17.72			43.48	1.35					47.9	38.9	3.5	0.8												2160
38	28-Feb-86	500	75	5.7	35.0	6.91				43.48	1.35	2725	1330	1811	0.73																2160
39	01-Mar-86	500	75	6.1	36.0	6.91	16.57			43.48	1.35																				2160
40	02-Mar-86	500	75	6.1	36.0	6.88				43.48	1.35																				2160
41	03-Mar-86	500	75	6.0	35.0	6.85	15.62			43.48	1.35	2690	1345	1735	0.78	47.1	38.1	4.0	1.0												2160
42	04-Mar-86	500	75	6.2	35.0	6.83				43.48	1.35																				2160
43	05-Mar-86	500	75	6.3	34.0	6.82	14.67			43.48	1.35									7170	2370	3110	1090				7910	2875	2680	90.4	2160
	AVERAGE	500	75	6.1	35.0	6.88	16.15	0.544	43.48	1.35	2723	1338	1773	0.76	47.5	38.3	4.2	0.9	7170	2370	3110	1090				7910	2875	2680	90.4	2160
44	06-Mar-86	500	75	6.3	35.0	6.80				43.48	1.35					45.4	39.0	4.4	0.9												2160
45	07-Mar-86	500	75	6.0	34.0	6.80	16.00			43.48	1.35	2569	1463	1550	0.94																2160
46	08-Mar-86	500	75	6.0	35.0	6.77				43.48	1.35																				2160
47	09-Mar-86	500	75	6.0	35.0	6.77	16.72			43.48	1.35																				2160
48	10-Mar-86	500	75	6.3	34.0	6.78				43.48	1.35	2569	1672	1382	1.21	48.2	37.5	5.5	1.3												1920
49	11-Mar-86	400	60	6.0	35.0	6.76	18.00			54.35	1.00																				1920
50	12-Mar-86	400	60	6.1	35.0	6.77				54.35	1.00									9820							8440	3150	2875	91.3	1920
	AVERAGE	471	71	6.1	35.0	6.78	16.93	0.636	46.58	1.20	2569	1568	1456	1.09	46.8	38.3	5.0	1.1	9820							8440	3150	2875	91.3	2091
51	13-Mar-86	400	60	6.1	35.0	6.77	15.75			54.35	1.00					48.1	34.1	3.0	0.8												1920
52	14-Mar-86	400	60	6.2	36.0	6.74				54.35	1.00	2616	1886	1334	1.35																1920
53	15-Mar-86	400	60	6.2	36.0	6.77	15.73			54.35	1.00																				1920
54	16-Mar-86	400	60	6.2	35.0	6.78				54.35	1.00																				1920
55	17-Mar-86	400	60	6.0	35.0	6.75	14.87			54.35	1.00	2550	1663	1369	1.21	49.6	34.7	5.3	1.2												1920
56	18-Mar-86	400	60	6.2	35.5	6.78				54.35	1.00																				1920
57	19-Mar-86	400	60	5.3	35.0	6.78	16.29			54.35	1.00									9900	3730	4630	2100				8920	2880	2525	90.3	1810
	AVERAGE	400	60	6.0	35.4	6.77	15.66	0.697	54.35	1.00	2583	1735	1352	1.28	48.9	34.4	4.6	1.0	9900	3730	4630	2100				8920	2880	2525	90.3	1904
58	20-Mar-86	400	60	6.2	35.0	6.80				54.35	1.00					50.6	35.5	5.9	1.3												1810
59	21-Mar-86	400	60	6.0	35.0	6.75	12.96			54.35	1.00	2690	1666	1507	1.11																1810
60	22-Mar-86	400	60	6.0	35.0	6.76				54.35	1.00																				1810
61	23-Mar-86	400	60	6.0	35.0	6.74	15.10			54.35	1.00																				1810
62	24-Mar-86	400	60	6.0	36.0	6.73				54.35	1.00	2634	1716	1416	1.21	46.6	35.3	9.1	2.3												1810
63	25-Mar-86	400	60	6.2	35.0	6.73	13.70			54.35	1.00																				1810
64	26-Mar-86	400	60	6.2	35.0	6.75				54.35	1.00									10040							8770	3275	2820	87.0	1810
	AVERAGE	400	60	6.1	35.1	6.75	13.94	0.622	54.35	1.00	2662	1691	1462	1.16	48.6	35.4	7.5	1.8	10040							8770	3275	2820	87.0	1810

TABLE B-4 MONITORING DATA FOR LABORATORY-SCALE REACTOR 03.1

DAY	DATE	WWEY mL	SUPL mL	WWEY pH	TEMP C	DIG pH	BIOGAS METER L/d	SP BIO GASPROD BUBL L/d	SP BIO RATE m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK eq/L	VA eq/L	BA eq/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD eq/L	FILTER COD eq/L	FILTER BOD eq/L	FILTER BOD eq/L	TKN eq/L	NH3 eq/L	TP eq/L	TS eq/L	TSS eq/L	VSS eq/L	VSS %	SUPL COD eq/L
	16-Jan-86																														
	17-Jan-86																														
	18-Jan-86																														
	19-Jan-86																														
	20-Jan-86																														
	21-Jan-86																														
1	22-Jan-86	200	0	6.1	34.0	7.15																				3190	700	380	82.9	1380
	AVERAGE	200	0	6.1	34.0	7.15																				3190	700	380	82.9	1380
2	23-Jan-86	300	0	6.4	34.0	7.00			83.33	0.01						22.1	33.9	21.3	1.2											1709
3	24-Jan-86	300	0	6.3	34.5	7.00	7.18		83.33	0.01	2830	564	2430	0.23																1709
4	25-Jan-86	300	0	6.4	36.0	7.00			83.33	0.01																				1709
5	26-Jan-86	300	0	6.4	33.0	7.01	8.95		83.33	0.01																				1709
6	27-Jan-86	300	0	6.3	34.0	7.02			83.33	0.01	2804	591	2304	0.25																1709
7	28-Jan-86	400	60	6.3	35.0	7.02	12.22		54.35	1.00						45.6	36.9	6.1	1.1											1709
8	29-Jan-86	400	60	6.3	35.0	7.02			54.35	1.00										4700						4200	1015	1495	82.4	1709
	AVERAGE	329	17	6.3	34.5	7.01	9.45	0.460	75.05	0.09	2817	570	2407	0.24		33.9	35.4	13.7	1.2	4700						4200	1015	1495	82.4	1709
9	30-Jan-86	500	75	6.3	35.0	7.00	21.70		43.48	1.35																				1510
10	31-Jan-86	500	75	6.5	35.0	6.98			43.48	1.35	2867	1127	2067	0.55		45.7	39.2	4.4	1.0											1510
11	01-Feb-86	500	75	6.2	35.0	6.99	20.29		43.48	1.35																				1510
12	02-Feb-86	500	75	6.2	32.0	6.98			43.48	1.35																				1510
13	03-Feb-86	300	45	6.1	35.0	7.01	21.15		72.46	0.01	2941	1050	2190	0.48																1510
14	04-Feb-86	300	45	6.2	35.0	7.11			72.46	0.01						56.3	36.1	1.3	0.2											1510
15	05-Feb-86	300	45	6.2	35.0		15.91		72.46	0.01										4211	2546	1910	1660			4160	1425	1075	75.4	1510
	AVERAGE	414	62	6.0	34.6	7.01	19.76	0.757	55.90	1.12	2904	1093	2129	0.52		51.0	37.7	2.9	0.6	4211	2546	1910	1660			4160	1425	1075	75.4	1510
16	06-Feb-86	300	45	6.2	34.5	7.10			72.46	0.01																				1510
17	07-Feb-86	300	45	6.0	34.0	7.16	12.74		72.46	0.01	2969	761	2471	0.28		55.0	32.9	2.2	0.3											1510
18	08-Feb-86	400	60	6.3	35.0	7.09			54.35	1.00																				1510
19	09-Feb-86	400	60	6.3	35.0	7.10	16.38		54.35	1.00																				1510
20	10-Feb-86	400	60	6.2	34.0	7.11			54.35	1.00	3071	739	2495	0.30		52.3	43.7	3.3	0.4											1510
21	11-Feb-86	400	60	6.2	35.0	7.05	16.71		54.35	1.00																				1510
22	12-Feb-86	400	60	6.4	34.5	7.09			54.35	1.00										3350						4000	1225	1175	93.9	1510
	31452	371	56	5.9	34.6	7.11	15.27	0.645	59.52	1.00	3002	736	2483	0.29		53.7	38.3	2.8	0.4	3350						4000	1225	1175	95.9	1510
23	13-Feb-86	400	60	5.7	34.0	7.10	17.04		54.35	1.00						54.6	35.0	2.6	0.4											1660
24	14-Feb-86	400	60	4.9	36.0	7.12			54.35	1.00	3100	782	2545	0.31																1660
25	15-Feb-86	500	75	6.3	35.0	7.13	15.05		43.48	1.35																				1660
26	16-Feb-86	500	75	6.3	35.0	7.10			43.48	1.35																				1660
27	17-Feb-86	500	75	6.3	36.0	7.03	18.96		43.48	1.35	3062	776	2511	0.31		52.3	36.5	2.1	0.4											1660
28	18-Feb-86	500	75		35.0				43.48	1.35																				1660
29	19-Feb-86	500	75		34.0		18.67		43.48	1.35										3700	1600	1960	1160			4930	1750	1575	84.3	1660
	AVERAGE	471	71	5.9	35.0	7.10	17.63	0.590	46.50	1.27	3001	779	2520	0.31		53.5	35.0	2.4	0.4	3700	1600	1960	1160			4930	1750	1475	84.3	1660

TABLE B-5 MONITORING DATA FOR LABORATORY-SCALE REACTOR 64.0

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	BIO pH	NaOH 10.0 N mL	BIOGASPROD METER L/d	SP BIO RATE BUBL L/d	LOAD gCOD/kg VS	HRT d	LOAD RATE gCOD/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	FILTER COD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
	12-Sep-85																													
	13-Sep-85																													
	14-Sep-85																													
	15-Sep-85																													
	16-Sep-85																													
	17-Sep-85																													
1	18-Sep-85	300	0	6.2	35.5	7.40					83.33	0.81																		10350
	AVERAGE	300	0	6.2	35.5	7.40					83.33	0.81																		10350
2	19-Sep-85	300	0	6.1	35.5	7.33		1.14			83.33	0.81																		10350
3	20-Sep-85	300	0	6.1	35.0	7.25					83.33	0.81																		10350
4	21-Sep-85	0	0									0.00																		10350
5	22-Sep-85	0	0									0.00																		10350
6	23-Sep-85	300	0	6.2	35.5	7.38		5.74			83.33	0.81																		10350
7	24-Sep-85	400	0	6.2	35.5	7.25		1.81			62.50	1.09																		10350
8	25-Sep-85	400	0	6.2	35.0	7.22		2.69			62.50	1.00	11223	6391	6685	0.96														10350
	AVERAGE	243	0	6.2	35.3	7.29		2.84		0.173	75.00	0.66	11223	6391	6685	0.96														10350
9	26-Sep-85	400	0	3.4	35.5	7.10		2.43			62.50	1.00																		10350
10	27-Sep-85	400	0	3.5	35.5	7.20		1.65			62.50	1.00																		10350
11	28-Sep-85	0	0									0.00																		10350
12	29-Sep-85	0	0									0.00																		10350
13	30-Sep-85	400	200	6.1	44.0	7.51		3.83	9.4		41.67	1.00	11113	7240	5967	1.21														10350
14	01-Oct-85	400	0	4.2	38.5	7.48					62.50	1.00																		10350
15	02-Oct-85	400	0	3.4	31.0	7.21			13.0		62.50	1.00									19220	10020	1787	1320	449					10350
	AVERAGE	286	29	4.1	35.3	7.32		2.64	11.2	0.240	58.33	0.77	11113	7240	5967	1.21					19220	10020	1787	1320	449					10350
16	03-Oct-85	400	0	3.4	35.0	7.05	60				54.35	1.00					23.5	44.6	13.7	1.2										10350
17	04-Oct-85	400	0	6.3	35.0	7.02			19.2		62.50	1.00	10674	8322	4870	1.71														10350
18	05-Oct-85	0	0									0.01																		10350
19	06-Oct-85	0	0									0.00																		10350
20	07-Oct-85	400	0	6.1	35.5	7.30			8.9		62.50	1.00	10297	7620	4805	1.59														10350
21	08-Oct-85	400	0	6.1	35.5	7.20	20	1.74			59.52	1.00																		10350
22	09-Oct-85	400	0	6.1	35.0	7.30		0.84			62.50	1.00									21520									10350
	AVERAGE	286	0	5.6	35.2	7.17		1.29	14.0	0.125	60.27	0.77	10486	7975	4838	1.65	23.5	44.6	13.7	1.2	21520									10350
23	10-Oct-85	400	0	4.3	35.0	7.20					62.50	1.00																		10350
24	11-Oct-85	400	200	4.3	37.0	7.20		12.29	12.7		41.67	1.00	11427	8509	5361	1.61														10350
25	12-Oct-85	0	0									.00																		10350
26	13-Oct-85	0	0									.00																		10350
27	14-Oct-85	500	0	4.3							50.00	1.35																		10350
28	15-Oct-85	500	25	3.8	41.0	7.35					47.62	1.35	10540	7561	5104	1.48	49.3	32.0	5.6	1.3										10350
29	16-Oct-85	500	25	3.8	39.0	7.30		14.75	18.2		47.62	1.35									20320	12090	1700	973	420	24490	5350	3675	66.2	10350
	AVERAGE	329	36	4.1	38.0	7.26		13.52	15.5	1.130	49.08	0.89	10900	8035	5203	1.54	49.3	32.0	5.6	1.3	20320	12090	1700	973	420	24490	5350	3675	66.2	10350

TABLE B-5 MONITORING DATA FOR LABORATORY-SCALE REACTOR 84.0 (CONT'D)

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TABLE B-5 MONITORING DATA FOR LABORATORY-SCALE REACTOR 04.0 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	BIO pH	NaOH 10.6 N mL	BIOGASPROD METER L/d	BUBL L/d	SP BIO RATE m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	H2 %	O2 %	FILTER COD COD mg/L	FILTER BOD BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
65	21-Nov-85	600	30	6.2	34.0	7.02		18.56			39.60	1.62					51.9	39.4	3.0	0.6										19470
66	22-Nov-85	600	30	4.5	35.0	6.90	50	17.47	16.3		36.76	1.62	7691	5782	3586	1.61														19470
67	23-Nov-85	600	30	4.5	35.0	7.20		13.21			39.60	1.62																		19470
68	24-Nov-85	600	30	4.5	34.5	7.01		15.35			39.60	1.62																		19470
69	25-Nov-85	600	30	6.2	34.5	6.94	25	14.54	16.1		38.17	1.62	7877	6360	3361	1.89														19470
70	26-Nov-85	600	30	6.2	35.0	7.03	25	12.01			38.17	1.62					41.0	37.1	6.9	1.6										19470
71	27-Nov-85	600	30	6.2	35.0	7.02			15.4		39.60	1.62									21340	7700	1671	735	520	26570	4300	2775	64.5	19470
	AVERAGE	600	30	5.5	34.7	7.02		15.36	15.9	0.575	38.03	1.62	7784	6071	3474	1.75	46.5	38.3	5.0	1.1	21340	7700	1671	735	520	26570	4300	2775	64.5	19470
72	28-Nov-85	600	30	6.2	35.0	7.00					39.60	1.62																		54470
73	29-Nov-85	600	30	5.2	35.5	7.03			19.2		39.60	1.62	8621	6509	4000	1.63	55.3	37.4	3.4	0.5										54470
74	30-Nov-85	600	30	6.1	35.0	7.01					39.60	1.62																		54470
75	01-Dec-85	0	0									0.01																		54470
76	02-Dec-85	600	30	6.2	34.0	7.15					39.60	1.62	8863	6864	3738	1.61														54470
77	03-Dec-85	600	30	6.2	35.0	6.98	25	15.78			38.17	1.62					50.7	39.0	2.0	0.2										54470
78	04-Dec-85	600	30	6.2	36.0	7.10			28.4		39.60	1.62									23560					24000	4525	2625	58.0	54470
	AVERAGE	514	26	6.0	35.1	7.06		15.78	19.0	0.793	39.43	1.39	8342	6287	3879	1.62	53.2	38.6	2.7	0.4	23560					24000	4525	2625	58.0	54470
79	05-Dec-85	600	30	5.4	35.5	6.95	25	21.53			38.17	1.62					48.7	41.4	1.5	0.2										54470
80	06-Dec-85	600	30	4.7	35.5	7.02			16.6		39.60	1.62	8633	6672	3896	1.71														54470
81	07-Dec-85	600	30	4.5	35.0	7.02		18.46			39.60	1.62																		54470
82	08-Dec-85	600	30	4.5	35.0	6.95	25				38.17	1.62																		54470
83	09-Dec-85	600	30	6.1	35.0	7.02	25	13.16	15.1		38.17	1.62	8112	6664	3381	1.97														54470
84	10-Dec-85	600	30	6.2	35.5	7.05					39.60	1.62					53.9	34.1	2.1	0.3										54470
85	11-Dec-85	600	30	6.2	35.5	7.00	25	18.24			38.17	1.62									23950	9000	1614	640	481	26760	4850	3325	68.6	17200
	AVERAGE	600	30	5.4	35.3	7.00		17.85	15.9	0.712	38.82	1.62	8373	6668	3639	1.84	51.3	37.8	1.8	0.3	23950	9000	1614	640	481	26760	4850	3325	68.6	49146
86	12-Dec-85	600	30	6.2	35.0	6.95	50				36.76	1.62																		17200
87	13-Dec-85	600	30	6.2	35.0	7.22		9.98	13.4		39.60	1.62	8869	6687	4121	1.62														17200
88	14-Dec-85	600	30	6.2	35.0	7.00					39.60	1.62																		17200
89	15-Dec-85	600	30	6.2	35.0	6.96	25	16.07			38.17	1.62																		17200
90	16-Dec-85	600	30	6.2	35.0	7.00	25		10.0		38.17	1.62	8683	6894	3788	1.82	52.0	35.6	2.0	0.2										17200
91	17-Dec-85	600	20	6.2	34.5	7.10		12.48			39.52	1.00																		17200
92	18-Dec-85	600	20	6.4	34.5	7.05					39.52	1.00									23160					27760	4450	2550	57.3	17200
	AVERAGE	543	27	6.2	34.9	7.05		12.84	12.1	0.545	44.50	1.46	8776	6791	3955	1.72	52.0	35.6	2.0	0.2	23160					27760	4450	2550	57.3	17200
93	19-Dec-85	600	20	5.7	36.0	7.12		12.79			59.52	1.00																		17750
94	20-Dec-85	600	20	5.9	36.0	7.10					59.52	1.00	8993	7368	3762	1.96	48.6	38.9	3.1	0.5										17750
95	21-Dec-85	600	20	6.2	35.0	7.10		11.48			59.52	1.00																		17750
96	22-Dec-85	600	20	6.2	35.0	7.10					59.52	1.00																		17750
97	23-Dec-85	600	20	6.3	35.0	7.13		12.12			59.52	1.00	8600	7099	3560	1.99														16500
98	24-Dec-85	600	20	5.9	35.0	7.12					59.52	1.00																		
99	25-Dec-85	600	20	5.9	35.0			11.49			59.52	1.00									22810	10760	1500	620	490	26900	4050	2200	54.3	16500
	AVERAGE	600	20	6.0	35.3	7.11		11.97		0.609	59.52	1.00	8801	7234	3665	2.34	48.6	38.9	3.1	0.5	22810	10760	1500	620	490	26900	4050	2200	54.3	17393

TABLE B-5 MONITORING DATA FOR LABORATORY-SCALE REACTOR 84.0 (CONT'D)

Day	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	DIG pH	NaOH 10.6 M mL	BIOGASPROD METER L/d	BUBL L/d	SP BIO RATE m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	FILTER BOD mg/L	BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
100	26-Dec-85	400	20	6.2	34.0					59.52	1.00																				16500
101	27-Dec-85	400	20	6.1	35.0	7.00				59.52	1.00	8149	6202	3689	1.70																16500
102	28-Dec-85	400	20	6.2	35.0	7.12		12.27		59.52	1.00																				16500
103	29-Dec-85	400	20	6.2	35.0	7.12				59.52	1.00																				16500
104	30-Dec-85	400	20	6.3	35.0	7.10		12.49		59.52	1.00	7002	5622	3810	1.48	51.4	36.5	2.4	0.4												16500
105	31-Dec-85	400	20	6.2	35.0	7.29				59.52	1.00																				16500
106	01-Jan-86	400	20	6.2	35.0	7.25		11.43		59.52	1.00										21300						25400	4575	3825	66.1	16500
	AVERAGE	400	20	6.2	34.9	7.16		12.86	0.671	59.52	1.00	7976	5952	3750	1.59	51.4	36.5	2.4	0.4	21300						25400	4575	3825	66.1	16500
107	02-Jan-86	400	20	6.4	35.0	7.23				59.52	1.00					51.2	37.0	3.2	0.6												16500
108	03-Jan-86	400	20	6.2	35.5	7.26		13.52		59.52	1.00	7777	5492	3878	1.42																16500
109	04-Jan-86	400	20	6.2	35.0	7.29				59.52	1.00																				16500
110	05-Jan-86	400	20	6.2	35.0	7.33		11.60		59.52	1.00																				16500
111	06-Jan-86	400	20	6.3	35.0	7.21				59.52	1.00	7442	4962	3919	1.27	48.2	36.4	8.4	1.9												16500
112	07-Jan-86	400	20	4.9	35.0	7.23		13.68		59.52	1.00																				16500
113	08-Jan-86	400	20	5.1	35.0	7.25				59.52	1.00										19850		8660				24560	4225	2875	68.0	16500
	AVERAGE	400	20	5.9	35.1	7.26		12.93	0.683	59.52	1.00	7610	5227	3899	1.35	49.7	36.7	5.8	1.3	19850			8660			24560	4225	2875	68.0	16500
114	09-Jan-86	400	20	3.9	35.0	7.23		15.99		59.52	1.00					49.2	37.9	3.4	0.7												16500
115	10-Jan-86	400	20	6.2	35.0	7.20				59.52	1.00	7430	4777	4030	1.18																16500
116	11-Jan-86	400	20	6.2	35.0	7.21		15.47		59.52	1.00																				16500
117	12-Jan-86	400	20	6.2	35.0	7.24				59.52	1.00																				16500
118	13-Jan-86	400	20	6.3	35.0	7.21		14.94		59.52	1.00	7145	4674	3827	1.22						19800						23160	4250	2950	64.8	16500
119	14-Jan-86																														
120	15-Jan-86																														
121	AVERAGE	400	20	5.0	35.0	7.22		15.47	0.833	59.52	1.00	7288	4726	3933	1.20	49.2	37.9	3.4	0.7	19800						23160	4250	2950	64.8	16500

TABLE B-6 MONITORING DATA FOR LABORATORY-SCALE REACTOR 84.1

DAY	DATE	WWEY mL	SUPL mL	WWEY pH	TEMP C	DIG pH	BIOGASPROD METER L/d	SP BIO RATE BUBL L/d	m3/kg COD UR	HRT d	LOAD RATE g/d	ALK eq/L	VA eq/L	BA eq/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD eq/L	FILTER COD eq/L	FILTER BOD eq/L	TKN eq/L	NH3 eq/L	TP eq/L	TS eq/L	TSS eq/L	VSS eq/L	VSS %	SUPL COD eq/L
	16-Jan-86																													
	17-Jan-86																													
	18-Jan-86																													
	19-Jan-86																													
	20-Jan-86																													
	21-Jan-86																													
1	22-Jan-86	200	500	6.1	34.0	7.15																				4660	1560	1400	89.7	11020
	AVERAGE	200	500	6.1	34.0	7.15																								11020
2	23-Jan-86	200	500	6.4	34.0	7.09	7.15			35.71	0.78					43.7	29.7	13.8	0.9											11910
3	24-Jan-86	300	500	6.3	34.5	7.10				31.25	1.05	3886	220	2850	0.08															11910
4	25-Jan-86	300	500	6.4	36.0	7.09	9.97			31.25	1.05																			11910
5	26-Jan-86	300	500	6.4	33.0	7.08				31.25	1.05																			11910
6	27-Jan-86	300	500	6.3	34.0	7.10	12.00			31.25	1.05	2981	247	2726	0.09	50.5	37.5	3.8	0.7											11910
7	28-Jan-86	400	60	6.3	35.0	7.08				54.35	1.00																			1789
8	29-Jan-86	400	60	6.3	35.0	7.10	15.37			54.35	1.00									4250						5540	1425	1125	78.9	1789
	AVERAGE	314	374	6.3	34.5	7.09	11.17		0.493	38.49	1.02	2954	234	2780	0.09	47.1	33.6	8.0	0.8	4250						5540	1425	1125	79	9018
9	30-Jan-86	500	75	6.3	35.0	7.10				43.48	1.35					50.9	36.0	4.2	1.0											1510
10	31-Jan-86	500	75	6.5	35.0	7.06	22.60			43.48	1.35	2792	220	2636	0.08															1510
11	01-Feb-86	500	75	6.2	35.0	7.04				43.48	1.35																			1510
12	02-Feb-86	500	75	6.2	32.0	7.01	21.79			43.48	1.35																			1510
13	03-Feb-86	500	75	6.1	35.0	7.01				43.48	1.35	2746	241	2575	0.09	54.1	37.7	1.4	0.2											1510
14	04-Feb-86	500	75	6.2	35.0	7.02	22.79			43.48	1.35																			1510
15	05-Feb-86	500	75	6.2	35.0					43.48	1.35									5320	1151	740	130			6090	2200	1800	81.8	1510
	AVERAGE	500	75	6.0	34.6	7.04	22.39		0.729	43.48	1.35	2769	231	2604	0.09	52.5	36.9	2.8	0.6	5320	1151	740	130			6090	2200	1800	82	1510
16	06-Feb-86	500	75	6.2	34.5	7.00	23.97			43.48	1.35					53.7	36.5	2.9	0.7											1510
17	07-Feb-86	500	75	4.0	34.0	7.03				43.48	1.35	2588	234	2422	0.10															1510
18	08-Feb-86	600	90	6.3	35.0	7.00	25.00			36.23	1.62																			1510
19	09-Feb-86	600	90	6.3	35.0	7.00				36.23	1.62																			1510
20	10-Feb-86	600	90	6.2	34.0	7.00	24.71			36.23	1.62	2476	241	2305	0.11	53.6	35.5	3.7	0.9											1510
21	11-Feb-86	600	90	6.2	35.0	6.95				36.23	1.62																			1510
22	12-Feb-86	600	90	6.4	34.5	6.99	26.70			36.23	1.62									6620										
	AVERAGE	571	86	5.9	34.6	7.01	25.11		0.733	38.30	1.54	2532	238	2364	0.11	53.7	36.0	3.3	0.8	6620										1510
23	13-Feb-86	600	90	5.7	34.0	6.98				36.23	1.62					54.7	35.8	1.5	0.4											1600
24	14-Feb-86	600	90	4.9	36.0	6.99	27.13			36.23	1.62	2355	259	2171	0.12															1600
25	15-Feb-86	700	105	6.3	35.0	6.98				31.06	1.09																			1600
26	16-Feb-86	700	105	6.3	35.0	6.98	30.98			31.06	1.09																			1600
27	17-Feb-86	700	105	6.3	36.0	6.95				31.06	1.09	2299	247	2124	0.12	54.6	36.0	4.0	1.2											1600
28	18-Feb-86	700	105		35.0		34.27			31.06	1.09									7930	911	1750	220			8920	3050	4300	89.1	1600
29	19-Feb-86	700	105		34.0					31.06	1.09																			
	AVERAGE	671	101	5.9	35.0	6.98	30.80		0.785	32.53	1.81	2327	253	2148	0.12	54.7	35.9	3.2	0.8	7930	911	1750	220			8920	3050	4300	89.1	1600

TABLE B-6 MONITORING DATA FOR LABORATORY-SCALE REACTOR 84.1 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	DIG pH	BIOGASPROD METER L/d	BUBL L/d	SP BIO RATE m3/kg COD	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
65	27-Mar-86	1000	150		35.0					21.74	2.70																			1810
66	28-Mar-86	1000	150		35.0					21.74	2.70																			1810
67	29-Mar-86	1000	150		35.0					21.74	2.70																			1810
68	30-Mar-86	1000	150		35.0					21.74	2.70																			1810
69	31-Mar-86	1000	150		35.0					21.74	2.70																			1810
70	01-Apr-86	1000	150		35.0					21.74	2.70																			1810
71	02-Apr-86	1000	150		35.0					21.74	2.70																			1810
	AVERAGE	1000	150		35.0					21.74	2.70																			1810
72	03-Apr-86	1000	0		35.0	7.00				25.00	2.69	1945	134	1850	0.07					11796										1810
73	04-Apr-86	1000	0		35.0					25.00	2.69																			1810
74	05-Apr-86	1000	0		35.0					25.00	2.69																			1810
75	06-Apr-86	1000	0		35.0					25.00	2.69																			1810
76	07-Apr-86	1000	0		35.0					25.00	2.69																			1810
77	08-Apr-86	1000	0		35.0					25.00	2.69																			1810
78	09-Apr-86	1000	700		35.0					14.71	2.74																			1810
	AVERAGE	1000	100		35.0	7.00				23.53	2.70	1945	134	1850	0.07					11796										1810
79	10-Apr-86	1000	0		35.0					25.00	2.69	1890	214	1730	0.12					13210										1810
80	11-Apr-86	1000	0		35.0					25.00	2.69																			1810
81	12-Apr-86	1000	0		35.0					25.00	2.69																			1810
82	13-Apr-86	1000	0		35.0					25.00	2.69																			1810
83	14-Apr-86	1000	0		35.0					25.00	2.69																			1810
84	15-Apr-86	1000	0		35.0					25.00	2.69																			1810
85	16-Apr-86	1000	700		35.0					14.71	2.74																			1810
	AVERAGE	1000	100		35.0					23.53	2.70	1890	214	1730	0.12					13210										1810
86	17-Apr-86	1000	0		35.0					25.00	2.69	1955	433	1640	0.26					13440										1810
87	18-Apr-86	1000	0		35.0					25.00	2.69																			1810
88	19-Apr-86	1000	0		35.0					25.00	2.69																			1810
89	20-Apr-86	1000	0		35.0					25.00	2.69																			1810
90	21-Apr-86	1000	0		35.0					25.00	2.69																			1810
91	22-Apr-86	1000	0		35.0	6.46				25.00	2.69																			1810
92	23-Apr-86	0	0		35.0						0.00																			1810
	AVERAGE	857	0		35.0	6.46				25.00	2.31	1955	433	1640	0.26					13440										1810
93	24-Apr-86	0	0		35.0						0.00	2284	1412	1203	1.17					5090										1810
94	25-Apr-86	0	0		35.0						0.00																			1810
95	26-Apr-86	0	0		35.0						0.00																			1810
96	27-Apr-86	0	0		35.0						0.00																			1810
97	28-Apr-86	700	0		35.0	7.15				35.71	1.88																			1810
98	29-Apr-86	700	0		35.0					35.71	1.88																			1810
99	30-Apr-86	700	490		35.0					21.01	1.92																			1810
	AVERAGE	300	70		35.0	7.15				30.81	0.81	2284	1412	1203	1.17					5090										1810

TABLE B-6 MONITORING DATA FOR LABORATORY-SCALE REACTOR B4.1 (CONT'D)

DAY	DATE	WWEY	SUPL	WWEY	TEMP	DIG	BIOGASPROD METER	BUBL	SP BIO RATE	HRT	LOAD RATE	ALK	VA	BA	VA/BA	BIOGAS QUALITY CH4	CO2	N2	O2	COD	FILTER COD	BOD	FILTER BOD	TKN	NH3	TP	TS	TSS	VSS	VSS	SUPL COD
		mL	mL	pH	C	pH	L/d	L/d	m3/kg COD Ut	d	g/d	mg/L	mg/L	mg/L		%	%	%	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	%	mg/L
100	01-May-86	700	0		35.0	6.98				35.71	1.88	2541	649	2000	0.31					3400											1010
101	02-May-86	700	0		35.0					35.71	1.88																				1010
102	03-May-86	700	0		35.0					35.71	1.88																				1010
103	04-May-86	700	0		35.0					35.71	1.88																				1010
104	05-May-86	700	0		35.0					35.71	1.88																				1010
105	06-May-86	700	0		35.0					35.71	1.88																				1010
106	07-May-86	700	490		35.0					21.01	1.92																				1010
	AVERAGE	700	70		35.0	6.98				33.61	1.89	2541	649	2000	0.31					3400											1010
107	08-May-86	800	0		35.0	6.80				31.25	2.15	2439	913	1791	0.51					5695											1010
108	09-May-86	800	0		35.0					31.25	2.15																				1010
109	10-May-86	800	0		35.0					31.25	2.15																				1010
110	11-May-86	800	0		35.0					31.25	2.15																				1010
111	12-May-86	800	0		35.0					31.25	2.15																				1010
112	13-May-86	800	0		35.0					31.25	2.15																				1010
113	14-May-86	800	560		35.0					18.30	2.19																				1010
	AVERAGE	800	80		35.0	6.80				29.41	2.16	2439	913	1791	0.51					5695											1010
114	15-May-86	860	0		35.0	6.63				31.25	2.15	2495	1984	1086	1.83					10956											1010
115	16-May-86	800	0		35.0					31.25	2.15																				1010
116	17-May-86	0	0		35.0						0.00																				1010
117	18-May-86	0	0		35.0						0.00																				1010
118	19-May-86	0	0		35.0						0.00																				1010
119	20-May-86	700	0		35.0					35.71	1.88																				1010
120	21-May-86	700	560		35.0					20.16	1.92																				1010
	AVERAGE	429	77		35.0	6.63				29.59	1.16	2495	1984	1086	1.83					10956											1010
121	22-May-86	700	0		35.0	7.07				35.71	1.88	2718	343	2475	0.14					11469											1010
122	23-May-86	700	0		35.0					35.71	1.88																				1010
123	24-May-86	700	0		35.0					35.71	1.88																				1010
124	25-May-86	700	0		35.0					35.71	1.88																				1010
125	26-May-86	700	0		35.0					35.71	1.88																				1010
126	27-May-86	700	0		35.0					35.71	1.88																				1010
127	28-May-86	700	490		35.0					21.01	1.92																				1010
	AVERAGE	700	70		35.0	7.07	35.00		0.904	33.61	1.89	2718	343	2475	0.14					11469											1010
128	29-May-86	700	0		35.0	7.01				35.71	1.88	3672	380	2862	0.10					10813											1010
129	30-May-86	700	0		35.0					35.71	1.88																				1010
130	31-May-86	700	0		35.0					35.71	1.88																				1010
131	01-Jun-86	0	0		35.0						0.00																				1010
132	02-Jun-86	700	0		35.0					35.71	1.88																				1010
133	03-Jun-86	700	0		35.0					35.71	1.88																				1010
134	04-Jun-86	700	420		35.0					22.32	1.91																				1010
	AVERAGE	600	60		35.0	7.01				33.48	1.62	3672	380	2862	0.10					10813											1010

TABLE B-6 MONITORING DATA FOR LABORATORY-SCALE REACTOR 84.1 (CONT'D)

DAY	DATE	WWEY mL	SUPL mL	WWEY pH	TEMP C	BIO pH	SP BIO BIOGASPROD METER L/d	RATE BUBL L/d	m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	FILTER COD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
133	05-Jun-86	800	0	35.0						31.25	2.15	3081	269	2890	0.09														1810
134	06-Jun-86	800	0	35.0						31.25	2.15																		1810
137	07-Jun-86	800	0	35.0						31.25	2.15																		1810
138	08-Jun-86	0	0	35.0							0.00																		1810
139	09-Jun-86	800	0	35.0						31.25	2.15																		1810
140	10-Jun-86	800	0	35.0						31.25	2.15																		1810
141	11-Jun-86	800	400	35.0						19.53	2.19																		1810
	AVERAGE	686	69	35.0						29.30	1.85	3081	269	2890	0.09														1810
142	12-Jun-86	800	0	35.0						31.25	2.15	2960	252	2781	0.09					9601									1810
143	13-Jun-86	800	0	35.0						31.25	2.15																		1810
144	14-Jun-86	800	0	35.0						31.25	2.15																		1810
145	15-Jun-86	0	0	35.0							0.00																		1810
146	16-Jun-86	800	0	35.0						31.25	2.15																		1810
147	17-Jun-86	800	0	35.0						31.25	2.15																		1810
148	18-Jun-86	800	400	35.0						19.53	2.19																		1810
	AVERAGE	686	69	35.0						29.30	1.85	2960	252	2781	0.09					9601									1810
149	19-Jun-86	800	0	35.0						31.25	2.15	2830	282	2630	0.11					10423									1810
150	20-Jun-86	800	0	35.0						31.25	2.15																		1810
151	21-Jun-86	800	0	35.0						31.25	2.15																		1810
152	22-Jun-86	0	0	35.0							0.00																		1810
153	23-Jun-86	800	0	35.0						31.25	2.15																		1810
154	24-Jun-86	800	0	35.0						31.25	2.15																		1810
155	25-Jun-86	800	0	35.0						31.25	2.15																		1810
	AVERAGE	686	0	35.0						31.25	1.85	2830	282	2630	0.11					10423									1810
156	26-Jun-86	800	0	35.0						31.25	2.15	2690	1695	1487	1.14					10553									1810
157	27-Jun-86																												
158	28-Jun-86																												
159	29-Jun-86																												
160	30-Jun-86																												
161	01-Jul-86																												
162	02-Jul-86																												
	AVERAGE	800	0	35.0	34.60		0.762	31.25	2.15	2690	1695	1487	1.14					10553									1810	

TABLE B-7 MONITORING DATA FOR LABORATORY-SCALE REACTOR 85.0

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	DIG pH	NaOH 10.6 mL	BIOGAS METER	SP BIO GASPROD DUBL L/d	RATE m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	FILTER BOD mg/L	BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
	12-Sep-85																														
	13-Sep-85																														
	14-Sep-85																														
	15-Sep-85																														
	16-Sep-85																														
	17-Sep-85																														
1	18-Sep-85	300	0	6.2	35.5	7.40	0.0				83.33	0.81																			10350
	AVERAGE	300	0	6.2	35.5	7.40	0.0				83.33	0.81																			10350
2	19-Sep-85	300	0	6.1	35.5	7.32	0.0				83.33	0.81																			10350
3	20-Sep-85	300	0	6.1	35.0	7.21	0.0				83.33	0.81																			10350
4	21-Sep-85	0	0				0.0					0.00																			10350
5	22-Sep-85	0	0				0.0					0.00																			10350
6	23-Sep-85	300	0	6.2	35.5	7.30	0.0				83.33	0.81																			10350
7	24-Sep-85	400	0	6.2	35.5	7.20	0.0	10.36			62.50	1.00																			10350
8	25-Sep-85	400	0	6.2	35.5	7.15	0.0	12.86	15.6		62.50	1.00	10830	6438	6259	1.03															10350
	AVERAGE	243	0	6.2	35.4	7.24	0.0	11.21	15.6		75.00	0.65	10830	6438	6259	1.03															10350
9	26-Sep-85	400	0	5.4	35.5	7.11	0.0	11.90			62.50	1.00																			10350
10	27-Sep-85	400	0	5.5	35.5	7.15	0.0	10.67	20.4		62.50	1.00																			10350
11	28-Sep-85	0	0				0.0					0.00																			10350
12	29-Sep-85	0	0				0.0					0.00																			10350
13	30-Sep-85	400	400	6.1	44.0	7.40	0.0				31.25	1.37	10799	6755	6003	1.13															10350
14	01-Oct-85	400	0	6.2	38.5	7.35	0.0				62.50	1.00																			10350
15	02-Oct-85	400	0	5.4	31.0	7.14	0.0	6.67	11.0		62.50	1.00									10720	11360		1700	1331	223					10350
	AVERAGE	206	57	4.1	35.3	7.23	0.0	9.75	16.1	0.815	56.25	0.81	10799	6755	6003	1.13					10720	11360		1700	1331	223					10350
16	03-Oct-85	400	0	5.4	35.0	7.00	0.0	7.90			62.50	1.00					29.4	40.3	8.7	0.3											10350
17	04-Oct-85	400	0	6.2	35.0	6.95	60.0	11.34	13.4		45.45	1.00	10322	8845	3954	2.24															10350
18	05-Oct-85	0	0				0.0					0.00																			10350
19	06-Oct-85	0	0				0.0					0.00																			10350
20	07-Oct-85	400	0	6.1	35.5	7.25	60.0	14.47	5.0		45.45	1.00	10171	8248	4232	1.95															10350
21	08-Oct-85	400	0	6.1	35.5	7.41	0.0	5.23			62.50	1.00																			10350
22	09-Oct-85	400	0	6.1	35.0	7.25	10.0	5.09			60.98	1.00									19660										10350
	AVERAGE	206	0	5.6	35.2	7.17	44.3	8.81	9.2	0.851	55.38	0.77	10247	8547	4093	2.09	29.4	40.3	8.7	0.3	19660										10350
23	10-Oct-85	400	0	4.3	35.0	7.20	0.0				62.50	1.00																			10350
24	11-Oct-85	400	400	4.3	37.0	7.20	0.0		12.2		31.25	1.37	10962	8458	4720	1.83															10350
25	12-Oct-85	0	0				0.0					0.00																			10350
26	13-Oct-85	0	0				0.0					0.00																			10350
27	14-Oct-85	500	0	4.3			0.0				50.00	1.35																			10350
28	15-Oct-85	500	50	3.8	41.0	7.35	0.0				45.45	1.38	10674	8095	4846	1.67	43.3	38.2	9.0	2.2											10350
29	16-Oct-85	500	50	3.8	39.0	7.26	0.0	15.54	20.6		45.45	1.38									19490	13260		1700	1253	250	23330	2775	1950	70.3	10350
	AVERAGE	329	71	4.1	38.0	7.25	0.0	15.54	16.4	1.192	46.93	0.94	10818	8377	4787	1.75	43.3	38.2	9.0	2.2	19490	13260		1700	1253	250	23330	2775	1950	70.3	10350

TABLE B-7 MONITORING DATA FOR LABORATORY-SCALE REACTOR #5.0 (CONT'D)

DAY	DATE	WWEY	SUPL	WWEY	TEMP	DIG	NaOH	BIOGAS METER	BIOGASPROD	SP BIO RATE	HRT	LOAD RATE	ALK	VA	BA	VA/BA	BIOGAS QUALITY CH4	CO2	N2	O2	COD	FILTER COD	BOD	FILTER BOD	TKN	NH3	TP	TS	TSS	VSS	VSS	SUPL COD
		gL	gL	pH	C	pH	10.6 N	L/d	L/d	m3/kg COD Ut	d	g/d	mg/L	mg/L	mg/L		%	%	%	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	%	mg/L
30	17-Oct-85	500	50	6.4	36.0	7.15	50.0	12.90			41.67	1.38																				
31	18-Oct-85	500	50	5.0	37.0	7.10	0.0	14.38	7.9		45.45	1.38	10422	7924	4717	1.68	47.5	37.4	2.7	0.5												18350
32	19-Oct-85	500	50	5.0	36.0	7.43	0.0	6.84			45.45	1.38																				18350
33	20-Oct-85	500	50	5.0	36.0	7.23	0.0	9.03			45.45	1.38																				18350
34	21-Oct-85	500	50	6.2	32.5	7.20	0.0	8.51	22.0		45.45	1.38	11213	8377	5102	1.62																18350
35	22-Oct-85	500	50	3.6	38.0	7.12	50.0				41.67	1.38																				18350
36	23-Oct-85	500	50	5.9	37.0	7.42	0.0		17.0		45.45	1.38					48.2	35.8	2.9	0.4												18350
																					18270						24000	1500	900	60.0	18350
	AVERAGE	500	50	5.0	36.1	7.24	14.3	10.16	16.2	0.410	44.37	1.38	10818	8151	4950	1.65	47.9	36.6	2.8	0.5	18270						24000	1500	900	60.0	18350
37	24-Oct-85	500	50	6.2	38.0	7.30	0.0	10.40			45.45	1.38																				
38	25-Oct-85	500	50	6.1	35.5	7.25	0.0	12.17	16.6		45.45	1.46	11659	8243	5724	1.44																18350
39	26-Oct-85	500	50	6.2	37.0	7.25	0.0	12.12			45.45	1.46																				58490
40	27-Oct-85	500	50	6.2	38.0	7.25	0.0	15.50			45.45	1.46																				58490
41	28-Oct-85	500	50	6.2	35.0	7.15	50.0	15.84	7.9		41.67	1.46	10705	8303	4810	1.73	52.1	36.2	3.2	0.6												58490
42	29-Oct-85	500	50	6.2	34.0	7.60	0.0	0.16			45.45	1.46																				58490
43	30-Oct-85	500	50	6.2	35.5	7.35	0.0	12.02	13.2		45.45	1.46																				58490
																					19310	11460		1693	1167	264	22850	4425	3875	69.5	58490
	AVERAGE	500	50	6.2	36.1	7.31	7.1	12.32	12.6	0.482	44.91	1.45	11182	8273	5267	1.59	52.1	36.2	3.2	0.6	19310	11460		1693	1167	264	22850	4425	3875	69.5	52756
44	31-Oct-85	500	50	6.1	35.0	7.20	0.0	17.85			45.45	1.46																				
45	01-Nov-85	500	50	6.1	35.5	7.25	0.0	20.53	22.8		45.45	1.46	10978	7116	5926	1.20	52.5	36.4	1.6	0.2												58490
46	02-Nov-85	500	50	6.1	38.0	7.25	0.0				45.45	1.46																				58490
47	03-Nov-85	500	50	6.1	37.0	7.20	0.0				45.45	1.46																				58490
48	04-Nov-85	500	50	6.1	36.5	7.30	0.0		26.2		45.45	1.46	10667	6835	5814	1.18																58490
49	05-Nov-85	500	50	6.2	35.0	7.25	0.0				45.45	1.46					52.9	35.3	3.0	0.7												58490
50	06-Nov-85	500	50	6.1	35.0	7.23	0.0		20.2		45.45	1.46																				58490
																					20220						24000	4675	2300	69.2	58490
	AVERAGE	500	50	6.1	36.0	7.24	0.0	19.19	23.1	0.754	45.45	1.46	10823	6976	5870	1.19	52.7	35.9	2.3	0.5	20220						24000	4675	2300	69.2	58490
51	07-Nov-85	500	50	6.2	35.0	7.22	0.0				45.45	1.46																				
52	08-Nov-85	500	50	5.2	36.0	7.20	0.0		22.1		45.45	1.46	10233	6131	5000	1.04																58490
53	09-Nov-85	500	50	6.2	33.0	7.22	0.0	17.29			45.45	1.46																				58490
54	10-Nov-85	500	50	6.2	35.0	7.32	0.0	20.16			45.45	1.46																				58490
55	11-Nov-85	600	60	6.2	34.0	7.27	0.0	17.80	24.2		37.88	1.76	9799	5337	6010	0.89																58490
56	12-Nov-85	600	60	6.2	35.0	7.19	0.0	26.16			37.88	1.76																				58490
57	13-Nov-85	600	60	5.7	36.0	7.20	0.0	27.98	35.0		37.88	1.76					53.5	35.3	2.5	0.5												58490
																					19960	7660		1720	945	369	24000	3350	2400	67.6	58490
	AVERAGE	543	54	6.0	34.9	7.23	0.0	21.80	27.1	0.784	42.21	1.59	10016	5734	5945	0.97	53.5	35.3	2.5	0.5	19960	7660		1720	945	369	24000	3350	2400	67.6	58490
58	14-Nov-85	600	60	6.2	35.0	7.25	0.0	21.68			37.88	1.76																				
59	15-Nov-85	600	60	6.2	34.5	7.20	0.0	20.86	25.7		37.88	1.66	9191	5411	5349	1.01	51.3	31.5	2.3	0.5												58490
60	16-Nov-85	600	60	6.2	34.0	7.25	0.0				37.88	1.66																				18780
61	17-Nov-85	600	60	6.2	35.0	7.22	0.0				37.88	1.66																				18780
62	18-Nov-85	600	60	6.7	35.0	7.20	0.0		25.7		37.88	1.66	8832	4982	5295	0.94																18780
63	19-Nov-85	600	60	6.1	38.0	7.25	0.0				37.88	1.66																				18780
64	20-Nov-85	600	60	6.1	36.5	7.30	0.0		26.6		37.88	1.66																				19470
																					19780						23650	2250			19470
	AVERAGE	600	60	5.7	35.4	7.24	0.0	20.87	26.0	0.723	37.88	1.67	9012	5197	5322	0.98	51.3	31.5	2.3	0.5	19780						23650	2250			24630

TABLE B-7 MONITORING DATA FOR LABORATORY-SCALE REACTOR 05.0 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	BIO pH	NaOH 10.6 N mL	BIOGASPROD METER L/d	BUBL L/d	SP BIO RATE m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK eq/L	VA eq/L	BA eq/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD eq/L	FILTER COD eq/L	FILTER BOD eq/L	BOD eq/L	TKN eq/L	NH3 eq/L	TP eq/L	TS eq/L	TSS eq/L	VSS eq/L	VSS %	BAPL COD eq/L
65	21-Nov-85	600	60	6.2	34.0	7.20	0.0				37.00	1.66					55.6	36.7	1.4	0.3												19470
66	22-Nov-85	600	60	4.5	35.0	7.25	0.0	10.52	21.0		37.00	1.66	8187	4670	4071	0.96																19470
67	23-Nov-85	600	60	4.5	35.0	7.22	0.0	23.24			37.00	1.66																				19470
68	24-Nov-85	600	60	4.5	34.5	7.18	0.0	19.00			37.00	1.66																				19470
69	25-Nov-85	600	60	6.2	34.5	7.12	0.0	21.06	24.9		37.00	1.66	7815	4485	4631	0.97																19470
70	26-Nov-85	700	70	6.2	35.0	7.16	0.0	25.32			32.47	1.94																				19470
71	27-Nov-85	700	70	6.2	35.0	7.05	0.0	24.31	24.9		32.47	1.94									18210		4750		1700	850	384	21200	3375	2275	67.4	19470
	AVERAGE	629	63	5.5	34.7	7.18	0.0	21.92	23.9	0.707	36.33	1.74	8001	4570	4751	0.97	55.6	36.7	1.4	0.3	18210		4750		1700	850	384	21200	3375	2275	67.4	19470
72	28-Nov-85	700	70	6.2	35.0	7.06	0.0	22.99			32.47	2.04																				54470
73	29-Nov-85	700	70	5.2	35.5	7.10	0.0		28.3		32.47	2.04	7698	4492	3819	1.18	52.1	38.6	0.9	0.2												54470
74	30-Nov-85	700	70	6.1	35.0	7.12	0.0				32.47	2.04																				54470
75	01-Dec-85	0	0				0.0					0.00																				54470
76	02-Dec-85	700	70	6.2	34.0	7.41	0.0				32.47	2.04	6649	3121	4433	0.70																54470
77	03-Dec-85	700	70	6.2	35.0	7.10	0.0	18.98			32.47	2.04					54.6	36.9	1.2	0.2												54470
78	04-Dec-85	700	70	6.2	34.0	7.15	0.0		29.9		32.47	2.04									19120						20600	3700	2375	64.2	54470
	AVERAGE	600	60	6.0	35.1	7.16	0.0	20.99	29.1	0.725	32.47	1.75	6829	3807	4126	0.94	53.4	37.8	1.1	0.2	19120						20600	3700	2375	64.2	54470
79	05-Dec-85	700	70	5.4	35.5	7.12	0.0	22.11			32.47	2.04					54.5	37.5	0.9	0.2												54470
80	06-Dec-85	700	70	4.7	35.5	7.10	0.0		22.8		32.47	2.04	6463	3707	3831	0.97																54470
81	07-Dec-85	750	75	4.5	35.0	7.19	0.0	20.32			30.30	2.18																				54470
82	08-Dec-85	750	75	4.5	35.0	7.11	0.0				30.30	2.18																				54470
83	09-Dec-85	750	75	6.1	35.0	7.05	0.0	20.73	31.9		30.30	2.18	6970	3425	3646	0.94																54470
84	10-Dec-85	750	75	6.2	35.5	7.04	0.0				30.30	2.18					51.1	35.9	1.7	0.4												54470
85	11-Dec-85	750	75	6.2	35.5	7.05	0.0	25.68			30.30	2.07									18720		5130		1786	725	409	21440	4050	2825	69.8	17200
	AVERAGE	736	74	5.4	35.3	7.09	0.0	22.21	27.4	0.585	30.92	2.12	6271	3566	3739	0.96	52.8	36.7	1.3	0.3	18720		5130		1786	725	409	21440	4050	2825	69.8	49146
86	12-Dec-85	750	75	6.2	35.0	7.05	0.0				30.30	2.07																				17200
87	13-Dec-85	750	75	6.2	35.0	7.02	0.0	22.00	29.3		30.30	2.07	5830	3610	3267	1.10																17200
88	14-Dec-85	750	75	6.2	35.0	7.00	0.0				30.30	2.07																				17200
89	15-Dec-85	750	75	6.2	35.0	7.00	0.0	24.78			30.30	2.07																				17200
90	16-Dec-85	750	75	6.2	35.0	7.00	0.0		26.9		30.30	2.07	5396	3410	2975	1.15	50.1	37.7	1.2	0.2												17200
91	17-Dec-85	750	75	6.2	34.5	6.99	25.0	23.91			29.41	2.07																				17200
92	18-Dec-85	750	75	6.4	34.5	7.05	0.0		23.0		30.30	2.07									18720						19070	4150	2650	63.9	17200
	AVERAGE	750	75	6.2	34.9	7.02	3.6	23.56	26.4	0.650	30.18	2.07	5613	3510	3121	1.13	50.1	37.7	1.2	0.2	18720						19070	4150	2650	63.9	17200
93	19-Dec-85	750	75	5.7	36.0	7.05	0.0	22.62			30.30	2.07																				17750
94	20-Dec-85	750	75	5.9	36.0	7.00	0.0		26.4		30.30	2.07	5830	3700	3146	1.20	51.3	37.6	1.4	0.3												17750
95	21-Dec-85	750	75	6.2	35.0	7.03	0.0	23.14			30.30	2.07																				17750
96	22-Dec-85	750	75	6.2	35.0	7.00	0.0				30.30	2.07																				17750
97	23-Dec-85	750	75	6.3	35.0	7.02	0.0	24.42	34.3		30.30	2.07	5185	3581	2643	1.36																17750
98	24-Dec-85	750	75	5.9	35.0	7.00	0.0				30.30	2.07																				16550
99	25-Dec-85	750	75	5.9	35.0		25.0	24.11			29.41	2.07									18990		5940		1671	660	355	21420	3875	2375	61.3	16550
	AVERAGE	750	75	6.0	35.3	7.02	3.6	23.57	30.4	0.654	30.18	2.07	5508	3681	2895	1.20	51.3	37.6	1.4	0.3	18990		5940		1671	660	355	21420	3875	2375	61.3	17487

TABLE B-7 MONITORING DATA FOR LABORATORY-SCALE REACTOR 05.0 (CONT'D)

											SP BIO							BIOGAS QUALITY													
		WHEY	SUPL	WHEY	TEMP	DIG	NaOH	BIOGASPROD		RATE		LOAD									FILTER		FILTER							SUPL
DAY	DATE	mL	mL	pH	C	pH	10.6 N	METER	BUBL	m3/kg	HRT	RATE	ALK	VA	BA	VA/BA	CH4	CO2	N2	O2	COD	COD	BOD	BOD	TKN	NH3	TP	TS	TSS	VSS	VSS	COD
								L/d		COD Ut	d	g/d	eq/L	eq/L	eq/L		%	%	%	%	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	%	eq/L
100	26-Dec-85	750	75	6.2	34.0		0.0				30.30	2.07																			
101	27-Dec-85	750	75	6.1	35.0	6.92	25.0				29.41	2.07	5389	3711	2674	1.39															
102	28-Dec-85	750	75	6.2	35.0	6.98	25.0	18.47			29.41	2.07																			
103	29-Dec-85	750	75	6.2	35.0	7.06	0.0				30.30	2.07																			
104	30-Dec-85	750	75	6.3	35.0	6.95	0.0	22.71	20.0		30.30	2.07	5700	3986	2950	1.35	46.1	37.8	4.1	1.0											
105	31-Dec-85	750	75	6.2	35.0	7.22	25.0				29.41	2.07																			
106	01-Jan-86	750	75	6.2	35.0	7.13	0.0	23.83			30.30	2.07									20200						22000	4450	3575	76.9	16550
	AVERAGE	750	75	6.2	34.9	7.04	10.7	21.67	20.0	0.623	29.92	2.07	5545	3849	2812	1.37	46.1	37.8	4.1	1.0	20200						22000	4450	3575	76.9	16550
107	02-Jan-86	750	75	6.4	35.0	7.05	0.0				30.30	2.07					46.3	39.7	3.3	0.8											
108	03-Jan-86	750	75	6.2	35.5	7.05	0.0	26.90			30.30	2.07	5917	4646	2618	1.77															
109	04-Jan-86	750	75	6.2	35.0	7.03	0.0				30.30	2.07																			
110	05-Jan-86	750	75	6.2	35.0	7.10	0.0	26.63			30.30	2.07																			
111	06-Jan-86	750	75	6.3	35.0	7.00	25.0				29.41	2.07	5569	4453	2265	2.05	45.5	35.5	8.2	2.1											
112	07-Jan-86	750	75	6.9	35.0	7.11	0.0	25.96			30.30	2.07																			
113	08-Jan-86	750	75	5.1	35.0	7.05	0.0				30.30	2.07									20830		8450				22100	3850	2850	74.0	16550
	AVERAGE	750	75	5.9	35.1	7.06	3.6	26.53		0.770	30.18	2.07	5743	4450	2442	1.91	45.9	37.6	5.8	1.5	20830		8450				22100	3850	2850	74.0	16550
114	09-Jan-86	750	75	3.9	35.0	7.00	0.0	27.81			30.30	2.07					47.2	38.2	4.4	1.1											
115	10-Jan-86	750	75	6.2	35.0	6.98	25.0				29.41	2.07	5830	4900	2351	2.08															
116	11-Jan-86	700	70	6.2	35.0	7.05	0.0	22.40			32.47	1.93																			
117	12-Jan-86	700	70	6.2	35.0	7.05	0.0				32.47	1.93																			
118	13-Jan-86	700	70	6.3	35.0	7.00	0.0	26.35			32.47	1.93	5966	4722	2613	1.81															
119	14-Jan-86	700	70	5.4	32.0	6.92	25.0				31.45	1.93					49.1	36.6	4.1	0.9											
120	15-Jan-86	700	70	5.2	34.0	7.00	0.0	28.16			32.47	1.97									21150						22140	3850	2700	70.1	29640
	AVERAGE	714	71	5.6	34.4	7.00	7.1	24.18		0.741	31.58	1.98	5898	4811	2482	1.95	48.2	37.4	4.3	1.0	21150						22140	3850	2700	70.1	18334
121	16-Jan-86	700	70	4.9	36.0	6.95	25.0	28.86			31.45	1.97																			
122	17-Jan-86	700	70	6.4	35.0	7.11	0.0				32.47	1.97	6302	5347	2486	2.22															
123	18-Jan-86	700	70	6.1	35.0	7.02	0.0	29.79			32.47	1.97																			
124	19-Jan-86	700	70	6.1	35.5	6.93	25.0				31.45	1.97																			
125	20-Jan-86	700	70	6.0	35.0	7.06	0.0	21.81			32.47	1.97	6413	5031	2842	1.77	51.7	29.9	5.6	1.4											
126	21-Jan-86	700	70	6.0	35.0	6.95	25.0	23.90			31.45	1.97																			
127	22-Jan-86	700	70	6.1	34.0		0.0				32.47	1.97									21560		7360				21000	3150	2250	71.4	29640
	AVERAGE	700	70	5.7	35.1	7.00	10.7	25.09		0.881	32.03	1.97	6308	5109	2624	2.00	51.7	29.9	5.6	1.4	21560		7360				21000	3150	2250	71.4	29640
128	23-Jan-86	700	70	6.4	34.0	6.98	0.0	24.19			32.47	1.97					46.3	35.1	6.4	1.6											
129	24-Jan-86	700	70	6.3	34.5	6.98	0.0				32.47	1.97	6397	5512	2484	2.22															
130	25-Jan-86	600	60	6.4	36.0	7.11	0.0	22.50			37.88	1.68																			
131	26-Jan-86	600	60	6.4	33.0	7.07	0.0				37.88	1.68																			
132	27-Jan-86	600	60	6.3	34.0	7.04	0.0	24.93			37.88	1.68	6572	5471	2688	2.04	50.5	38.0	3.7	0.9											
133	28-Jan-86	600	60	6.3	35.0	7.01	0.0				37.88	1.68																			
134	29-Jan-86	600	60	6.3	35.0	7.02	0.0	25.82			37.88	1.68									21030						21720	4000	3300	82.5	29640
	AVERAGE	629	63	6.3	34.5	7.02	0.0	24.38		0.822	36.33	1.77	6485	5492	2586	2.13	48.4	36.6	5.1	1.3	21030						21720	4000	3300	82.5	29640

TABLE B-8 MONITORING DATA FOR LABORATORY-SCALE REACTOR #5.1

DAY	DATE	INFLUENT VOL mL	SUPPL VOL mL	INFLUENT pH	TEMP C	BIOGAS METER pH	BIOGASPROD METER L/d	SP BIO GAS PROD RATE BUBL L/d	SP BIO GAS PROD RATE mJ/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	FILTER COD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPPL COD mg/L
	30-Jan-86																												
	31-Jan-86																												
1	01-Feb-86	250	0	6.2	35.0	7.19			100.00	0.67																			
2	02-Feb-86	260	0	6.2	32.0	7.10	8.30		96.15	0.70																			
3	03-Feb-86	0	0	6.1	35.0	7.00			0.00	0.00	4254	2461	2507	0.98	52.4	37.7	4.6	0.2											
4	04-Feb-86	500	0	6.2	35.0	7.15	7.87		50.00	1.33																			
5	05-Feb-86	300	0	6.2	35.0				83.33	0.81									11930	6010	3180	2030		13180	2025	1300	64.2		
	AVERAGE	262	0	6.2	34.4	7.11	8.08	0.577	82.37	0.71	4254	2461	2507	0.98	52.4	37.7	4.6	0.2	11930	6010	3180	2030		13180	2025	1300	64.2		
6	06-Feb-86	250	0	6.2	34.5	7.11	15.01		100.00	0.67					50.5	40.5	2.7	0.4											
7	07-Feb-86	0	840	4.0	34.0	7.00			29.76	0.05	4161	2481	2480	1.00															
8	08-Feb-86	500	0	6.3	35.0	7.00	9.50		50.00	1.33																			1510
9	09-Feb-86	340	0	6.3	35.0	7.00			73.53	0.92																			
10	10-Feb-86	0	0	6.2	34.0	3.50	15.90		0.00	0.00	4002	2110	2490	0.85	49.9	38.2	2.3	0.3											
11	11-Feb-86	450	0	6.2	35.0	7.12			55.56	1.21																			
12	12-Feb-86	250	0	6.4	34.5	7.02	17.14		100.00	0.67									11010					13190	1750	1325	75.7		
	AVERAGE	256	120	5.9	34.6	6.54	14.43	1.081	68.14	0.70	4082	2300	2489	0.93	50.2	39.4	2.5	0.4	11010					13190	1750	1325	75.7		1510
13	13-Feb-86	150	0	5.7	34.0	7.07			166.67	0.60					50.0	38.1	5.1	1.1											
14	14-Feb-86	200	420	4.9	34.0	7.12	14.15		40.32	0.57	4170	1838	2065	0.64															
15	15-Feb-86	450	0	6.3	35.0	7.15			55.56	1.21																			1600
16	16-Feb-86	450	0	6.3	35.0	7.06	16.53		55.56	1.21																			
17	17-Feb-86	0	0	6.3	34.0	6.95			0.00	0.00	4002	1785	2735	0.65	48.5	39.9	2.4	0.4											
18	18-Feb-86	480	0		35.0		10.61		62.50	1.00																			
19	19-Feb-86	150	0		34.0				166.67	0.60									9160	2730	3110	1730		11840	3150	2575	81.7		
	AVERAGE	257	60	5.9	35.0	7.07	13.77	0.924	91.21	0.70	4086	1812	2800	0.65	49.7	39.0	3.0	0.8	9160	2730	3110	1730		11240	3150	2575	81.7		1600
20	20-Feb-86	0	0		34.0	7.12	11.10		0.00						54.4	33.5	2.9	0.4											
21	21-Feb-86	250	0	6.4	34.0	7.31			100.00	0.67	4086	937	3421	0.27															
22	22-Feb-86	250	0	6.4	34.0	7.27	9.35		100.00	0.67																			
23	23-Feb-86	340	0	6.4	35.0	7.20			73.53	0.92																			
24	24-Feb-86	0	0	6.2	36.0	7.00	11.95		0.00	0.00	4068	1950	3323	0.32	49.8	38.6	3.9	0.6											
25	25-Feb-86	0	0	6.0	35.0	7.18			0.00	0.00																			
26	26-Feb-86	460	0	6.1	35.0	7.39	4.70		54.35	1.24									7300					10340	2375	2025	85.3		
	AVERAGE	186	0	6.3	34.7	7.22	9.38	0.905	81.97	0.50	4077	994	3372	0.30	52.1	36.1	3.4	0.5	7300					10340	2375	2025	85.3		
27	27-Feb-86	550	420	6.3	34.0	7.20			25.77	1.52					48.5	38.1	3.2	0.5											
28	28-Feb-86	360	0	5.7	35.0	7.09	18.31		44.64	1.51	3975	1160	3151	0.37															2160
29	01-Mar-86	340	0	6.1	36.0	7.03			73.53	0.92																			
30	02-Mar-86	300	0	6.1	36.0	7.02	17.21		83.33	0.81																			
31	03-Mar-86	0	0	6.0	35.0	7.01			0.00	0.00	3909	1559	2892	0.56	49.6	38.5	2.3	0.4											
32	04-Mar-86	500	0	6.2	35.0	7.22	8.19		50.00	1.33																			
33	05-Mar-86	250	0	6.3	34.0	7.11			100.00	0.67									7060	1920	2770	1170		9660	4225	3725	88.2		
	AVERAGE	357	60	6.1	35.0	7.10	14.57	0.692	62.88	0.97	3942	1360	2977	0.47	49.1	38.3	2.8	0.5	7060	1920	2770	1170		9660	4225	3725	88.2	2160	

TABLE B-8 MONITORING DATA FOR LABORATORY-SCALE REACTOR #5.1 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	DIG pH	BIOGAS/PROD METER L/d	SP BIO RATE BIOGAS L/d	SP BIO RATE g/g COD UP	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	H2 %	O2 %	COD mg/L	FILTER COD mg/L	FILTER BOD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
34	06-Mar-86	360	0	6.3	35.0	7.13	15.05			69.44	0.97					49.5	37.2	3.0	0.5												
35	07-Mar-86	400	0	6.0	34.0	7.00				62.50	1.00	3835	1419	2820	0.50																
36	08-Mar-86	350	0	6.0	35.0	7.02	10.63			45.45	1.40																				
37	09-Mar-86	200	0	6.0	35.0	6.96				125.00	0.54																				
38	10-Mar-86	0	0	6.3	36.0	7.10	10.02			0.00	0.00	3779	1710	2565	0.67	50.1	37.7	3.6	0.0												
39	11-Mar-86	300	0	6.0	35.0	7.23				83.33	0.81																				
40	12-Mar-86	0	840	6.1	35.0	7.17	13.47			29.76	0.86									8490						10500	4000	3425	85.6	1920	
	AVERAGE	259	120	6.1	35.0	7.09	16.29	1.110		69.25	0.71	3807	1565	2697	0.59	49.8	37.5	3.3	0.7	8490						10500	4000	3425	85.6	1920	
41	13-Mar-86	350	0	6.1	35.0	7.32				45.45	1.40					56.4	26.6	4.7	0.6												
42	14-Mar-86	300	0	6.2	36.0	7.11	10.27			50.00	1.35	3881	1044	3140	0.33																
43	15-Mar-86	400	0	6.2	36.0	7.09				62.50	1.08																				
44	16-Mar-86	450	0	6.2	35.0	7.11	17.75			55.56	1.21																				
45	17-Mar-86	0	0	6.0	35.0	7.04				0.00	0.00	3779	1220	2913	0.42	58.7	36.0	3.1	0.7												
46	18-Mar-86	520	0	6.2	35.5	7.29	9.45			48.08	1.40																				
47	19-Mar-86	750	0	5.3	35.0	7.16				33.33	2.02									7470	1550	2000	810			9500	4525	4050	89.5		
	AVERAGE	453	0	6.0	35.4	7.16	15.16	0.560		49.15	1.22	3830	1132	3027	0.38	53.6	31.7	3.9	0.7	7470	1550	2000	810			9500	4525	4050	89.5		
48	20-Mar-86	300	840	6.2	35.0	7.02	23.20			21.93	0.87					47.3	39.6	4.1	1.0												1810
49	21-Mar-86	400	0	6.0	35.0	7.06				62.50	1.00	3723	1187	2980	0.41																
50	22-Mar-86	350	0	6.0	35.0	7.00	10.62			45.45	1.40																				
51	23-Mar-86	300	0	6.0	35.0	7.05				83.33	0.81																				
52	24-Mar-86	0	0	6.0	36.0	7.05	17.17			0.00	0.00	3742	1020	3000	0.34	56.3	35.6	3.9	0.0												
53	25-Mar-86	200	0	6.2	35.0	7.25				125.00	0.54																				
54	26-Mar-86	350	0	6.2	35.0	7.25	11.95			71.43	0.94									7640						8870	3750	3600	90.7		
	AVERAGE	300	120	6.1	35.1	7.11	17.73	1.007		68.27	0.82	3733	1104	2940	0.38	51.0	37.6	4.0	0.9	7640						8870	3750	3600	90.7	1810	

TABLE B-9 MONITORING DATA FOR LABORATORY-SCALE REACTOR 86.0

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	DIG pH	BIOGAS METER L/d	BIOGAS BUBL L/d	SP BIO RATE L3/kg COD UR	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	H2 %	O2 %	FILTER COD mg/L	FILTER BOD mg/L	FILTER SOD mg/L	IKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	INFL COD mg/L
	12-Sep-85																													
	13-Sep-85																													
	14-Sep-85																													
	15-Sep-85																													
	16-Sep-85																													
	17-Sep-85																													
1	18-Sep-85	300	0	6.2	35.5	7.50				83.33	0.81																			18350
	AVERAGE	300	0	6.2	35.5	7.50				83.33	0.81																			18350
2	19-Sep-85	300	0	6.1	35.5	7.32				83.33	0.81																			18350
3	20-Sep-85	300	0	6.1	35.0	7.25				83.33	0.81																			18350
4	21-Sep-85	0	0								0.00																			18350
5	22-Sep-85	0	0								0.00																			18350
6	23-Sep-85	300	0	6.2	35.5	7.35				83.33	0.81																			18350
7	24-Sep-85	400	0	6.2	35.5	7.24	5.89			62.50	1.08																			18350
8	25-Sep-85	400	0	6.2	35.5	7.20	4.67	17.3		62.50	1.08	11144	6438	6573	0.98															18350
	AVERAGE	243	0	6.2	35.4	7.27	4.88	17.3	0.299	75.00	0.65	11144	6438	6573	0.98															18350
9	26-Sep-85	400	0	3.4	35.5	7.16	6.19			62.50	1.08																			18350
10	27-Sep-85	400	0	3.5	35.5	7.20	4.67	16.1		62.50	1.08																			18350
11	28-Sep-85	0	0								0.00																			18350
12	29-Sep-85	0	0								0.00																			18350
13	30-Sep-85	400	400	6.1	32.0	7.36	9.24			31.25	1.37	10987	6270	6535	0.96															18350
14	01-Oct-85	400	0	4.2	30.5	7.32	0.89			62.50	1.08																			18350
15	02-Oct-85	400	0	3.4	31.0	7.09	1.40	10.8		62.50	1.08									19030	12410		1747	1393	255					18350
	AVERAGE	286	57	4.1	36.9	7.23	4.53	13.5	0.304	56.25	0.81	10987	6270	6535	0.96					19030	12410		1747	1393	255					18350
16	03-Oct-85	400	0	3.4	35.0	6.90	2.00			62.50	1.08					20.5	49.7	13.5	1.5											18350
17	04-Oct-85	400	0	6.2	35.0	6.92	3.70	11.5		62.50	1.08	10661	8650	4427	1.96															18350
18	05-Oct-85	0	0								0.00																			18350
19	06-Oct-85	0	0								0.00																			18350
20	07-Oct-85	400	0	6.1	35.5	7.05	4.73	6.7		62.50	1.08	9719	8755	3415	2.56															18350
21	08-Oct-85	400	0	6.1	35.5	7.04	2.47			62.50	1.08																			18350
22	09-Oct-85	400	0	6.1	35.0	7.00				62.50	1.08									20870										18350
	AVERAGE	286	0	5.6	35.2	6.98	3.24	9.1	0.298	62.50	0.77	10190	8787	3921	2.26	20.5	49.7	13.5	1.5	20870										18350
23	10-Oct-85	400	0	4.3	32.0	6.90				62.50	1.08																			18350
24	11-Oct-85	400	400	4.3	33.0	7.02		9.1		31.25	1.37	10171	9295	3507	2.64															18350
25	12-Oct-85	0	0								0.00																			18350
26	13-Oct-85	0	0								0.00																			18350
27	14-Oct-85	500	0	4.3						56.00	1.35																			18350
28	15-Oct-85	500	50	3.8	34.5	7.00				45.45	1.38	8689	6746	3832	1.76	27.7	48.6	4.1	1.1											18350
29	16-Oct-85	500	50	3.8	34.5	6.90		13.0		45.45	1.38									22100	15630		1690	1367	300	23130	3675	2250	73.2	18350
	AVERAGE	329	71	4.1	33.5	6.96		11.0	0.948	46.93	0.94	9430	8001	3670	2.20	27.7	48.6	4.1	1.1	22100	15630		1690	1367	300	23130	3675	2250	73.2	18350

TABLE B-9 MONITORING DATA FOR LABORATORY-SCALE REACTOR 66.0 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	DIG pH	BIOGASPROD METER L/d	BUBL L/d	SP BIO RATE m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	FILTER BOD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
30	17-Oct-85	500	50	4.4	35.0	6.75				45.45	1.38																				10350
31	18-Oct-85	500	50	5.0	34.5	6.65		16.3		45.45	1.38	9041	9822	1969	4.99	17.7	50.2	7.9	2.5												10350
32	19-Oct-85	0	0	5.0	35.0		0.09				0.00																				10350
33	20-Oct-85	0	0	5.0							0.00																				10350
34	21-Oct-85	0	0	6.2		6.65		2.9			0.00	9427	10749	1680	6.37																10350
35	22-Oct-85	0	0	3.6	35.0	6.50	0.21				0.00					33.0	48.1	9.0	1.9												10350
36	23-Oct-85	0	0	5.9	35.0	6.75	1.00				0.00									22970						20630	1375	1075	78.2	10350
	AVERAGE	143	14	5.0	34.9	6.68	3.10	9.6	-1.124	45.45	0.40	9234	10286	1829	5.68	25.4	45.2	8.5	2.2	22970						20630	1375	1075	78.2	10350
37	24-Oct-85	0	0	6.2	35.0	6.95					0.00																				10350
38	25-Oct-85	200	20	6.1	35.0	7.20		9.6		113.64	0.59	9303	9305	2546	3.69																50490
39	26-Oct-85	200	20	6.2	35.0	7.30				113.64	0.59																				50490
40	27-Oct-85	200	20	6.2	35.0	7.40				113.64	0.59																				50490
41	28-Oct-85	200	20	6.2	35.0	7.53		10.1		113.64	0.59	9489	8599	3385	2.54	60.1	19.0	7.3	2.1												50490
42	29-Oct-85	200	20	6.2	35.0	7.35				113.64	0.59																				50490
43	30-Oct-85	200	20	6.2	35.0	7.55	16.38	13.2		113.64	0.59									22950	14370			1787	1373	315	20260	3480	1975	58.1	50490
	AVERAGE	171	17	6.2	35.0	7.35	16.38	11.0	2.187	113.64	0.50	9396	8992	2946	3.12	60.1	19.0	7.3	2.1	22950	14370			1787	1373	315	20260	3480	1975	58.1	52756
44	31-Oct-85	200	20	6.1	35.0	7.45	9.87			113.64	0.59																				50490
45	01-Nov-85	200	20	6.1	35.0	7.50	7.72	11.0		113.64	0.59	9035	7710	3501	2.15	56.3	26.0	7.1	1.2												50490
46	02-Nov-85	200	20	6.1	35.0	7.50	9.87			113.64	0.59																				50490
47	03-Nov-85	200	20	6.1	35.0	7.45	9.19			113.64	0.59																				50490
48	04-Nov-85	300	30	6.1	35.0	7.60	0.35	16.6		75.76	0.80	9377	6857	4509	1.52																50490
49	05-Nov-85	300	30	6.2	35.0	7.50				75.76	0.80					52.9	25.4	9.1	1.8												50490
50	06-Nov-85	300	30	6.1	35.0	7.53				75.76	0.80									29180						29750	3100	1750	56.5	50490
	AVERAGE	243	24	6.1	35.0	7.50	9.00	13.8	0.715	97.40	0.71	9216	7284	4045	1.84	54.6	25.7	8.1	1.5	29180						29750	3100	1750	56.5	50490
51	07-Nov-85	300	30	6.2	35.0	7.55				75.76	0.80																				50490
52	08-Nov-85	300	30	5.2	35.0	7.55		15.1		75.76	0.80	9427	5323	5448	0.94																50490
53	09-Nov-85	400	40	6.2	34.0	7.65				56.82	1.17																				50490
54	10-Nov-85	400	40	6.2	35.0	7.70				56.82	1.17																				50490
55	11-Nov-85	400	40	6.2	35.0	7.66		15.1		56.82	1.17	9035	5397	5081	1.10	54.0	30.2	6.0	1.6												50490
56	12-Nov-85	400	40	6.2	35.0	7.60	14.00			56.82	1.17																				50490
57	13-Nov-85	400	40	5.7	35.0	7.60	17.50	19.9		56.82	1.17									17270	8600			1750	1310	294	18530	3600	2125	59.0	50490
	AVERAGE	371	37	6.0	34.9	7.62	16.19	16.7	0.000	62.23	1.09	9241	5460	5365	1.02	54.0	30.2	6.0	1.6	17270	8600			1750	1310	294	18530	3600	2125	59.0	50490
58	14-Nov-85	400	40	6.2	35.0	7.68	18.96			56.82	1.17																				50490
59	15-Nov-85	400	40	6.2	35.0	7.63	17.50	16.6		56.82	1.11	9142	5315	5360	0.99	53.2	27.5	4.3	1.1												10700
60	16-Nov-85	500	50	6.2	35.0	7.70	13.23			45.45	1.38																				10700
61	17-Nov-85	500	50	6.2	35.0	7.62	14.00			45.45	1.38																				10700
62	18-Nov-85	500	50	4.7	35.0	7.57		18.2		45.45	1.38	9129	5219	5424	0.96																10700
63	19-Nov-85	500	50	6.1	35.0	7.55				45.45	1.38																				19470
64	20-Nov-85	500	50	6.1	35.0	7.56		26.6		45.45	1.38									17450						17770	2975				19470
	AVERAGE	471	47	5.7	35.0	7.62	16.16	20.5	0.676	48.70	1.31	9136	5267	5396	0.98	53.2	27.5	4.3	1.1	17450						17770	2975				24450

TABLE B-9 MONITORING DATA FOR LABORATORY-SCALE REACTOR 66.0 (CONT'D)

DAY	DATE	WWEY mL	SUPL mL	WWEY pH	TEMP C	DIG pH	BIOGASPROD METER L/d	BUBL L/d	SP BIO RATE m3/kg COD UR	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	FILTER COD COD mg/L	FILTER BOD BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
65	21-Nov-85	500	50	6.2	35.0	7.59				45.45	1.38					55.0	36.7	3.7	1.1										19470
66	22-Nov-85	500	50	6.5	35.0	7.50		21.1		45.45	1.38	8360	5041	4781	1.05														19470
67	23-Nov-85	500	50	6.5	35.0	7.56				45.45	1.38																		19470
68	24-Nov-85	500	50	6.5	35.0	7.50				45.45	1.38																		19470
69	25-Nov-85	500	50	6.2	35.0	7.45	12.67	21.6		45.45	1.38	7777	5156	4187	1.21														19470
70	26-Nov-85	600	60	6.2	35.0	7.50	15.65			37.88	1.66					65.3	32.1	0.8	2.3										19470
71	27-Nov-85	600	60	6.2	35.0	7.38	22.05	20.9		37.88	1.66									17150	7020	1743	1214	200	16420	2725	2225	81.7	19470
	AVERAGE	529	53	5.5	35.0	7.50	16.79	21.2	0.629	43.29	1.46	8869	5099	4484	1.13	58.2	34.4	6.3	1.7	17150	7020	1743	1214	200	16420	2725	2225	81.7	19470
72	28-Nov-85	600	60	6.2	35.0	7.45	22.00			37.88	1.75																		54470
73	29-Nov-85	600	60	5.2	35.0	7.42	17.69	22.6		37.88	1.75	8838	5026	4470	1.12	56.0	36.1	1.6	0.6										54470
74	30-Nov-85	600	60	6.1	35.0	7.43				37.88	1.75																		54470
75	01-Dec-85	0	0								0.00																		54470
76	02-Dec-85	600	60	6.2	35.0	7.65				37.88	1.75	7310	4307	4260	1.01														54470
77	03-Dec-85	600	60	6.2	35.0	7.32	12.87			37.88	1.75					51.0	40.0	2.5	0.7										54470
78	04-Dec-85	600	60	6.2	35.0	7.35		29.9		37.88	1.75									17810					16910	3250	2325	71.5	54470
	AVERAGE	514	51	6.0	35.0	7.44	17.52	26.3	0.683	37.88	1.56	7670	4667	4365	1.07	53.9	38.1	2.1	0.7	17810					16910	3250	2325	71.5	54470
79	05-Dec-85	600	60	5.4	35.0	7.25	16.88			37.88	1.75					51.5	40.6	2.5	0.8										54470
80	06-Dec-85	600	60	4.7	35.0	7.25		14.6		37.88	1.75	7070	5360	3264	1.64														54470
81	07-Dec-85	650	65	4.5	35.0	7.27	16.05			34.97	1.89																		54470
82	08-Dec-85	650	65	4.5	35.0	7.22				34.97	1.89																		54470
83	09-Dec-85	650	65	6.1	35.0	7.20	19.05	25.7		34.97	1.89	6661	5604	2602	2.09														54470
84	10-Dec-85	650	65	6.2	35.0	7.15				34.97	1.89					52.0	34.9	2.3	0.7										54470
85	11-Dec-85	650	65	6.2	35.0	7.10	23.10			34.97	1.79									18720	10720	1900	1150	330	16400	3075	2325	75.6	17200
	AVERAGE	636	64	5.4	35.0	7.22	19.15	20.2	0.503	35.00	1.84	6866	5402	2973	1.87	52.2	37.8	2.4	0.8	18720	10720	1900	1150	330	16400	3075	2325	75.6	49146
86	12-Dec-85	650	65	6.2	35.0	7.20				34.97	1.79																		17200
87	13-Dec-85	650	65	6.2	35.0	7.20	21.00	22.0		34.97	1.79	6264	5374	2449	2.19														17200
88	14-Dec-85	650	65	6.2	35.0	7.22				34.97	1.79																		17200
89	15-Dec-85	650	65	6.2	35.0	7.22	21.32			34.97	1.79																		17200
90	16-Dec-85	650	65	6.2	35.0	7.25		30.0		34.97	1.79	6105	4915	2613	1.88	53.3	35.7	2.0	0.6										17200
91	17-Dec-85	650	65	6.2	35.0	7.29	22.31			34.97	1.79																		17200
92	18-Dec-85	650	65	6.4	35.0	7.25		23.0		34.97	1.79									18230					14850	3050	2700	70.1	17200
	AVERAGE	650	65	6.2	35.0	7.23	21.54	25.3	0.677	34.97	1.79	6184	5145	2531	2.04	53.3	35.7	2.0	0.6	18230					14850	3050	2700	70.1	17200
93	19-Dec-85	650	65	5.7	35.0	7.20	20.21			34.97	1.80																		17750
94	20-Dec-85	650	65	5.9	35.0	7.21		29.3		34.97	1.80	5867	4832	2436	1.98	53.2	34.7	2.6	0.8										17750
95	21-Dec-85	650	65	6.2	35.0	7.21	19.10			34.97	1.80																		17750
96	22-Dec-85	650	65	6.2	35.0	7.21				34.97	1.80																		17750
97	23-Dec-85	650	65	6.3	35.0	7.26	20.69	37.2		34.97	1.80	5835	4811	2439	1.97														17750
98	24-Dec-85	700	70	5.9	35.0	7.25				32.47	1.93																		16500
99	25-Dec-85	700	70	5.9	35.0		23.31			32.47	1.93									18080	10760	1714	1040	370	15400	3700	2825	76.4	16500
	AVERAGE	664	66	6.0	35.0	7.24	20.85	33.3	0.638	34.25	1.83	5861	4822	2438	1.98	53.2	34.7	2.6	0.8	18080	10760	1714	1040	370	15400	3700	2825	76.4	17393

TABLE B-9 MONITORING DATA FOR LABORATORY-SCALE REACTOR 66.0 (CONT'D)

DAY	DATE	INFLUENT mL	SUPL mL	INFLUENT pH	TEMP C	EFFLUENT pH	BIOGAS METER L/d	BIOGAS PROD BUBL L/d	SP BIO RATE m3/kg COD Ut	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	FILTER COD COD mg/L	FILTER COD COD mg/L	FILTER BOD BOD mg/L	FILTER BOD BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
100	26-Dec-85	700	70	6.2	35.0					32.47	1.93																				16500
101	27-Dec-85	700	70	6.1	35.0	7.05				32.47	1.93	5693	4825	2267	2.13																16500
102	28-Dec-85	700	70	6.2	35.0	7.05	20.84			32.47	1.93																				16500
103	29-Dec-85	660	66	6.2	35.0	7.00				37.00	1.65																				16500
104	30-Dec-85	660	66	6.3	35.0	7.00	20.01	24.5		37.00	1.65	5010	4983	2200	2.19	50.2	36.6	3.5	1.0												16500
105	31-Dec-85	660	66	6.2	35.0	7.20				37.00	1.65																				16500
106	01-Jan-86	660	66	6.2	35.0	7.32	18.32			37.00	1.65									18500							12900	4450	3850	86.5	16500
	AVERAGE	643	64	6.2	35.0	7.12	19.72	24.5	0.631	35.56	1.77	5756	4904	2274	2.16	50.2	36.6	3.5	1.0	18500							12900	4450	3850	86.5	16500
107	02-Jan-86	660	66	6.4	35.0	7.25				37.00	1.65					52.9	36.3	3.3	1.0												16500
108	03-Jan-86	660	66	6.2	35.0	7.20	17.64			37.00	1.65	5681	5093	2065	2.47																16500
109	04-Jan-86	660	66	6.2	35.0	7.32				37.00	1.65																				16500
110	05-Jan-86	660	66	6.2	35.0	7.32	18.59			37.00	1.65																				16500
111	06-Jan-86	660	66	6.3	35.0	7.32				37.00	1.65	5607	4873	2147	2.27	53.2	32.5	5.1	1.5												16500
112	07-Jan-86	660	66	6.9	35.0	7.20	18.90			37.00	1.65																				16500
113	08-Jan-86	660	66	5.1	35.0	7.33				37.00	1.65									18310		10760					14320	3475	2850	82.0	16500
	AVERAGE	660	66	5.9	35.0	7.29	18.40		0.628	37.00	1.65	5644	4983	2106	2.37	53.1	34.4	4.2	1.3	18310		10760					14320	3475	2850	82.0	16500
114	09-Jan-86	660	66	3.9	35.0	7.32	23.97			37.00	1.65					53.9	33.7	4.0	1.1												16500
115	10-Jan-86	660	66	6.2	35.0	7.33				37.00	1.65	5495	4646	2196	2.12																16500
116	11-Jan-86	660	66	6.2	35.0	7.39	20.04			37.00	1.65																				16500
117	12-Jan-86	660	66	6.2	35.0	7.41				37.00	1.65																				16500
118	13-Jan-86	660	66	6.3	35.0	7.33	20.27			37.00	1.65	5450	4289	2413	1.78	53.9	32.2	4.9	1.4												16500
119	14-Jan-86	660	66	5.4	35.0	7.37	22.12			37.00	1.65																				16500
120	15-Jan-86	660	66	5.2	35.0	7.32				37.00	1.60									17630							13560	4025	3125	77.6	29040
	AVERAGE	660	66	5.6	35.0	7.35	21.60		0.724	37.00	1.66	5477	4468	2305	1.95	53.9	33.0	4.5	1.3	17630							13560	4025	3125	77.6	18291
121	16-Jan-86	660	66	4.9	35.0	7.31	20.34			37.00	1.60																				29040
122	17-Jan-86	660	66	6.0	35.0	7.30				37.00	1.60	5210	4240	2194	1.94																29040
123	18-Jan-86	660	66	6.1	35.0	7.35	21.76			37.00	1.60																				29040
124	19-Jan-86	660	66	6.1	35.0	7.33				37.00	1.60																				29040
125	20-Jan-86	660	66	6.0	35.0	7.32	21.15			37.00	1.60	5297	3753	2632	1.43	53.1	31.0	5.1	1.4												29040
126	21-Jan-86	660	66	6.0	35.0	7.33				37.00	1.60																				29040
127	22-Jan-86	660	66	6.1	35.0		21.59			37.00	1.60									17570		8560					14270	4075	4200	86.2	29040
	AVERAGE	660	66	5.6	35.0	7.34	21.21		0.695	37.00	1.60	5254	4001	2413	1.69	53.1	31.0	5.1	1.4	17570		8560					14270	4075	4200	86.2	29040
128	23-Jan-86	660	66	6.4	35.0	7.22	21.76			37.00	1.60					52.7	31.6	5.3	1.5												29040
129	24-Jan-86	660	66	6.3	35.0	7.26				37.00	1.60	5170	3849	2437	1.58																29040
130	25-Jan-86	660	66	6.4	35.0	7.20	20.54			37.00	1.60																				29040
131	26-Jan-86	660	66	6.4	35.0	7.30				37.00	1.60																				29040
132	27-Jan-86	660	66	6.3	35.0	7.32	22.04			37.00	1.60	5091	3766	2417	1.56	54.1	33.6	4.9	1.4												29040
133	28-Jan-86	650	65	6.3	35.0	7.29				34.97	1.83																				29040
134	29-Jan-86	650	65	6.3	35.0	7.30	22.95			34.97	1.83									16830							13830	4650	3550	76.3	29040
	AVERAGE	614	61	6.3	35.0	7.28	22.02		0.693	37.05	1.73	5131	3808	2427	1.57	53.4	32.6	5.1	1.5	16830							13830	4650	3550	76.3	29040

TABLE B-9 MONITORING DATA FOR LABORATORY-SCALE REACTOR 66.0 (CONT'D)

									SP BIO							BIOGAS QUALITY														
								BIOGASPROD	RATE		LOAD									FILTER		FILTER									BUPL
		WWEY	SUPL	WWEY	TEMP	DIG	METER	BUBL	g3/kg	HRT	RATE	ALK	VA	BA	VA/BA	CH4	CO2	N2	O2	COD	COD	BOD	BOD	TKN	NH3	TP	TS	TSS	VSS	VSS	COD
DAY	DATE	mL	mL	pH	C	pH	L/d	L/d	COD	Ut	d	g/d	eq/L	eq/L	eq/L		%	%	%	%	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	%	eq/L
135	30-Jan-86	650	65	6.3	35.0	7.28					34.97	1.83																				29040
136	31-Jan-86	650	65	6.5	35.0	7.30	24.66				34.97	1.83	4807	3622	2315	1.56	52.5	32.2	6.2	1.7												29040
137	01-Feb-86	650	65	6.2	35.0	7.31					34.97	1.83																				29040
138	02-Feb-86	650	65	6.2	35.0	7.33	25.39				34.97	1.83																				29040
139	03-Feb-86	650	65	6.1	35.0	7.35					34.97	1.83	5026	3505	2530	1.38	58.5	33.6	1.6	0.6												29040
140	04-Feb-86	650	65	6.2	35.0	7.30	24.27				34.97	1.83																				29040
141	05-Feb-86	650	65		35.0						34.97	1.83									16973	8786	8430	5300				11840	6375	5250	82.4	29040
	AVERAGE	650	65	5.9	35.0	7.31	24.84		0.742		34.97	1.83	4937	3564	2427	1.47	55.5	32.9	3.9	1.2	16973	8786	8430	5300				11840	6375	5250	82.4	29040
142	06-Feb-86	650	65	6.2	35.0	7.30	26.65				34.97	1.83					56.4	33.0	2.0	0.6												29040
143	07-Feb-86	650	65	6.0	35.0	7.30					34.97	1.83	4877	3382	2476	1.37																29040
144	08-Feb-86	650	65	6.3	35.0	7.31	25.99				34.97	1.83																				29040
145	09-Feb-86	650	65	6.3	35.0	7.34					34.97	1.83																				29040
146	10-Feb-86	650	65	6.2	35.0	7.35	24.07				34.97	1.83	4877	3275	2352	1.28	54.9	32.6	3.0	0.9												29040
147	11-Feb-86	650	65	6.2	35.0	7.31					34.97	1.83																				29040
148	12-Feb-86	650	65	6.4	35.0	7.33	25.86				34.97	1.83									15490							13600	7650	5775	85.6	29040
	AVERAGE	650	65	5.9	35.0	7.34	25.64		0.742		34.97	1.83	4877	3329	2514	1.33	55.7	33.2	2.5	0.8	15490							13600	7650	5775	85.6	29040
149	13-Feb-86	650	65	5.7	35.0	7.34					34.97	1.83																				29040
150	14-Feb-86	650	65	6.9	35.0	7.33	23.87				34.97	1.83	4915	3328	2352	1.30																29040
151	15-Feb-86	650	65	6.3	35.0	7.32					34.97	1.83																				29040
152	16-Feb-86	650	65	6.3	35.0	7.32	24.86				34.97	1.83																				29040
153	17-Feb-86	650	65	6.3	35.0	7.30					34.97	1.83	4812	3198	2541	1.26	54.7	33.0	3.7	1.1												29040
154	18-Feb-86	700	70		35.0		26.45				32.47	1.97																				29040
155	19-Feb-86	700	70		35.0						32.47	1.97									16360	7600	10060	5610				12360	7100	6000	84.5	29040
	AVERAGE	664	66	5.9	35.0	7.32	25.06		0.722		34.25	1.87	4864	3263	2547	1.28	54.7	33.0	3.7	1.1	16360	7600	10060	5610				12360	7100	6000	84.5	29040
156	20-Feb-86	0	0		35.0	7.29	25.48					0.00					54.7	32.0	4.5	1.3												31590
157	21-Feb-86	700	70	6.4	35.0	7.61					32.47	1.97	4839	2543	3054	0.83																31590
158	22-Feb-86	700	70	6.4	35.0	7.38	22.60				32.47	1.97																				31590
159	23-Feb-86	700	70	6.4	35.0	7.38					32.47	1.97																				31590
160	24-Feb-86	700	70	6.2	35.0	7.33	23.56				32.47	1.97	4840	2960	2738	1.08	53.4	33.3	4.9	1.4												31590
161	25-Feb-86	700	70	6.0	35.0	7.32					32.47	1.97																				31590
162	26-Feb-86	700	70	6.1	35.0	7.41	20.00				32.47	1.97									15700							12290	7100	6300	88.7	31590
	AVERAGE	600	60	6.3	35.0	7.39	24.09		0.826		32.47	1.69	4850	2752	2096	0.96	54.1	32.7	4.7	1.4	15700							12290	7100	6300	88.7	31590
163	27-Feb-86	700	70	6.3	35.0	7.41					32.47	1.97					54.3	32.2	4.5	1.3												31590
164	28-Feb-86	700	70	5.7	35.0	7.43	26.92				32.47	1.97	4781	2924	2625	1.11																31590
165	01-Mar-86	700	70	6.1	35.0	7.45					32.47	1.97																				31590
166	02-Mar-86	700	70	6.1	35.0	7.42	27.11				32.47	1.97																				31590
167	03-Mar-86	700	70	6.0	35.0	7.45					32.47	1.97	4738	2885	2747	1.02	56.9	31.3	5.3	1.0												31590
168	04-Mar-86	750	75	6.2	35.0	7.42	26.00				30.30	2.11																				31590
169	05-Mar-86	750	75	6.3	35.0	7.44					30.30	2.11									15690	6040	7560	3310				12010	7050	6050	85.8	31590
	AVERAGE	714	71	6.1	35.0	7.43	26.95		0.709		31.85	2.01	4720	2865	2686	1.07	55.6	31.8	3.9	1.2	15690	6040	7560	3310				12010	7050	6050	85.8	31590

TABLE B-9 MONITORING DATA FOR LABORATORY-SCALE REACTOR 66.0 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	BIG pH	BIOGAS METER L/d	BIOGAS PROD BUBL L/d	SP BIO RATE m3/kg COD VA	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	H2 %	O2 %	FILTER COD mg/L	FILTER BOD mg/L	FILTER SOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
170	06-Mar-86	750	75	6.3	35.0	7.45	29.33			30.30	2.11					54.2	31.4	5.2	1.4											31590
171	07-Mar-86	750	75	6.0	35.0	7.42				30.30	2.11	4645	2020	2643	1.07															31590
172	08-Mar-86	750	75	6.0	35.0	7.42	28.50			30.30	2.11																			31590
173	09-Mar-86	750	75	6.0	35.0	7.42				30.30	2.11																			31590
174	10-Mar-86	750	75	6.3	35.0	7.44	30.39			30.30	2.11	4600	2793	2625	1.06	54.1	30.6	6.2	1.7											31590
175	11-Mar-86	000	00	6.0	35.0	7.46				28.41	2.25																			31590
176	12-Mar-86	000	00	6.1	35.0	7.41	29.48			28.41	2.25									14650						12130	7850	6800	86.6	31590
	AVERAGE	764	76	6.1	35.0	7.43	29.49		0.710	29.76	2.15	4627	2887	2634	1.07	54.2	31.0	5.7	1.6	14650						12130	7850	6800	86.6	31590
177	13-Mar-86	000	00	6.1	35.0	7.41				28.41	2.25					52.9	30.5	4.9	1.4											31590
178	14-Mar-86	000	00	6.2	35.0	7.38	29.17			28.41	2.25	4570	2909	2505	1.16															31590
179	15-Mar-86	000	00	6.2	35.0	7.41				28.41	2.25																			31590
180	16-Mar-86	000	00	6.2	35.0	7.40	27.03			28.41	2.25																			31590
181	17-Mar-86	000	00	6.0	35.0	7.40				28.41	2.25	4524	2775	2354	1.09	54.6	31.4	5.2	1.5											31590
182	18-Mar-86	000	00	6.2	35.0	7.38	27.15			28.41	2.25																			31590
183	19-Mar-86	000	00	5.3	35.0	7.40				28.41	2.25									15570	6250	6950	4270			12540	7600	6600	86.8	31590
	AVERAGE	000	00	6.0	35.0	7.40	27.70		0.651	28.41	2.25	4547	2842	2530	1.13	53.8	31.0	5.1	1.5	15570	6250	6950	4270			12540	7600	6600	86.8	31590
184	20-Mar-86	000	00	6.2	35.0	7.38	30.17			28.41	2.25					55.2	31.6	4.9	1.4											31590
185	21-Mar-86	000	00	6.0	35.0	7.34				28.41	2.25	4589	2921	2515	1.16															31590
186	22-Mar-86	000	00	6.0	35.0	7.33	27.77			28.41	2.25																			31590
187	23-Mar-86	000	00	6.0	35.0	7.32				28.41	2.25																			31590
188	24-Mar-86	000	00	6.0	35.0	7.32	27.09			28.41	2.25	4561	2998	2432	1.23	55.1	32.9	6.4	1.8											31590
189	25-Mar-86	000	00	6.2	35.0	7.34				28.41	2.25																			31590
190	26-Mar-86	000	00	6.2	35.0	7.35	29.55			28.41	2.25									15189						11890	6950	5950	85.6	31590
	AVERAGE	000	00	6.1	35.0	7.34	28.84		0.670	28.41	2.25	4575	2960	2474	1.20	55.2	32.3	5.7	1.6	15189						11890	6950	5950	85.6	31590

TABLE B-10 MONITORING DATA FOR LABORATORY-SCALE REACTOR 87.0

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	BIO pH	BIOGASPROD METER L/d	BUBL L/d	SP BIO RATE g3/kg COD UR	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	FILTER COD mg/L	FILTER BOD mg/L	BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
1	26-Sep-85	000	0	3.4	37.5	7.45				62.50	1.00																			18350
2	27-Sep-85	000	0	3.5	38.5	7.45				62.50	1.00																			18350
3	28-Sep-85	0	0								0.00																			18350
4	29-Sep-85	0	0								0.00																			18350
5	30-Sep-85	000	000	6.1	26.5	7.34				31.25	1.37	10334	4680	7011	0.67															18350
6	01-Oct-85	000	0	4.2	29.5	7.26	20.59			62.50	1.00																			18350
7	02-Oct-85	000	0	3.4	30.0	7.25	19.14			62.50	1.00									16000		8450		1700	1100	260				18350
	AVERAGE	571	114	4.1	32.4	7.35	19.86		0.775	56.25	0.81	10334	4680	7011	0.67					16000		8450		1700	1100	260				18350
8	03-Oct-85	000	0	3.4	35.0	7.25	13.26			62.50	1.00					51.1	40.6	1.0	0.5											18350
9	04-Oct-85	000	0	6.2	36.5	7.22	22.65			62.50	1.00	10204	4970	6700	0.74															18350
10	05-Oct-85	0	0								0.00																			18350
11	06-Oct-85	0	0								0.00																			18350
12	07-Oct-85	000	0	6.1	34.5	7.35				62.50	1.00	9983	5001	6382	0.78															18350
13	08-Oct-85	000	0	6.1	36.5	7.30	22.46			62.50	1.00																			18350
14	09-Oct-85	000	0	6.1	36.5	7.24	30.16			62.50	1.00									16840										
	AVERAGE	571	0	5.6	35.0	7.27	22.13		0.886	62.50	0.77	10134	4990	6541	0.76	51.1	40.6	1.0	0.5	16840										18350
15	10-Oct-85	000	0	4.3	35.0	7.17	19.31			62.50	1.00																			18350
16	11-Oct-85	000	000	4.3	36.0	7.00	9.00			31.25	1.37	9794	9971	5495	1.09															18350
17	12-Oct-85	0	0								0.00																			18350
18	13-Oct-85	0	0								0.00																			18350
19	14-Oct-85	1000	0	4.3						50.00	1.35																			18350
20	15-Oct-85	1000	100	3.8	40.0	7.37				45.45	1.38	9430	6330	4867	1.30	53.7	35.9	0.8	0.2											
21	16-Oct-85	1000	100	3.8	38.0	7.23	23.39			45.45	1.38									17340		8310		1920	1133	285	22090	8525	4125	74.7	18350
	AVERAGE	657	143	4.1	37.3	7.19	17.58		0.617	46.93	0.94	9612	6135	5181	1.20	53.7	35.9	0.8	0.2	17340		8310		1920	1133	285	22090	8525	4125	74.7	18350
22	17-Oct-85	1000	100	4.4	36.0	7.15	21.55			45.45	1.38																			18350
23	18-Oct-85	1000	100	5.0	37.0	7.10	23.50			45.45	1.38	8991	5745	4855	1.18	48.1	37.6	2.1	0.5											18350
24	19-Oct-85	1000	100	5.0	33.0	7.07	23.78			45.45	1.38																			18350
25	20-Oct-85	1000	100	5.0	35.0	7.02	21.60			45.45	1.38																			18350
26	21-Oct-85	1000	100	6.2	32.5	7.05	18.07			45.45	1.38	8869	6523	4172	1.56															18350
27	22-Oct-85	1000	100	3.6	38.0	6.95	32.83			45.45	1.38					46.3	40.0	1.4	0.3											
28	23-Oct-85	1000	100	5.9	37.0	6.90	35.14			45.45	1.38									16850						21640	2500	1475	64.1	18350
	AVERAGE	1000	100	5.0	35.0	7.03	25.31		0.500	45.45	1.38	8930	6134	4514	1.37	47.2	38.8	1.8	0.4	16850						21640	2500	1475	64.1	18350
29	24-Oct-85	1000	100	6.2	38.0	7.00	34.27			45.45	1.38																			18350
30	25-Oct-85	1000	100	6.1	35.5	7.00	30.83			45.45	1.46	8236	6703	3352	2.02															50490
31	26-Oct-85	1000	100	6.2	36.0	7.00	37.60			45.45	1.46																			50490
32	27-Oct-85	1000	100	6.2	38.0	7.00	33.29			45.45	1.46																			50490
33	28-Oct-85	1000	100	6.2	36.0	6.95	35.86			45.45	1.46	7887	6672	3140	2.12	54.0	36.4	0.8	0.2											50490
34	29-Oct-85	1000	100	6.2	34.0	6.85	32.38			45.45	1.46																			50490
35	30-Oct-85	1000	100	6.2	35.5	6.85	35.60			45.45	1.46									18500		9600		1727	1066	340	18090	5275	3325	63.0	50490
	AVERAGE	1000	100	6.2	36.1	6.95	34.29		0.657	45.45	1.45	8062	6720	3246	2.07	54.0	36.4	0.8	0.2	18500		9600		1727	1066	340	18090	5275	3325	63.0	52756

TABLE B-10 MONITORING DATA FOR LABORATORY-SCALE REACTOR 87.0 (CONT'D)

DAY	DATE	WHEY ml	SUPL ml	WHEY pH	TEMP C	BIO pH	BIOGAS/PROD METER L/d	SP BIO RATE BUBL L/d	g3/kg COD UR	HRT d	LOAD RATE g/d	ALK eq/L	VA eq/L	BA eq/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD eq/L	FILTER COD eq/L	FILTER BOD eq/L	TKN eq/L	NH3 eq/L	TP eq/L	TS eq/L	TSS eq/L	VSS eq/L	VSS %	SUPL COD eq/L
71	05-Dec-05	1300	130	5.4	35.5	6.98	54.13			34.97	1.89																			
72	06-Dec-05	1300	130	4.7	35.5	7.00	56.81			34.97	1.89	5619	3366	3272	1.01	56.5	35.7	0.8	0.2											
73	07-Dec-05	1400	140	4.5	35.0	7.03	51.45			32.47	2.04																			54470
74	08-Dec-05	1400	140	4.5	35.0	7.00	55.18			32.47	2.04																			54470
75	09-Dec-05	1400	140	6.1	35.0	7.00	50.90			32.47	2.04																			54470
76	10-Dec-05	1400	140	6.2	35.5	6.98	62.10			32.47	2.04	5297	3662	3123	0.98	53.6	33.8	1.9	0.5											54470
77	11-Dec-05	1400	140	6.2	35.5	6.98	62.37			32.47	2.04																			54470
										32.47	1.93																			54470
	AVERAGE	1371	137	5.4	35.3	7.00	56.14	0.749	33.10	1.98	5458	3184	3190	1.00	55.1	34.8	1.4	0.4	15940		3740		1671	843	314	17800	2980	2850	70.7	17200
																				15940		3740		1671	843	314	17800	2980	2850	70.7	49146
78	12-Dec-05	1400	140	6.2	35.0	6.98	61.69			32.47	1.93																			
79	13-Dec-05	1400	140	6.2	35.0	7.00	54.90			32.47	1.93	5210	3876	3026	1.02															17200
80	14-Dec-05	1400	140	6.2	35.0	7.02	63.32			32.47	1.93																			17200
81	15-Dec-05	1400	140	6.2	35.0	6.96	60.06			32.47	1.93																			17200
82	16-Dec-05	1400	140	6.2	35.0	7.00	54.60			32.47	1.93	5173	3817	3031	0.99	53.1	34.4	2.7	0.7											17200
83	17-Dec-05	1500	150	6.2	34.5	7.00	61.79			30.30	2.07																			17200
84	18-Dec-05	1500	150	6.4	34.5	6.95	61.01			30.30	2.07																			17200
																				16410										17200
	AVERAGE	1429	143	6.2	34.9	6.99	59.62	0.819	31.85	1.97	5192	3847	3029	1.01	53.1	34.4	2.7	0.7	16410				16880	3500	2350	72.9	17200
85	19-Dec-05	1500	150	5.7	36.0	7.00	61.90			30.30	2.07																			
86	20-Dec-05	1500	150	5.9	36.0	6.95	60.00			30.30	2.07	4900	3196	2631	1.21	52.7	34.6	2.0	0.7											17750
87	21-Dec-05	1500	150	6.2	35.0	6.96	61.52			30.30	2.07																			17750
88	22-Dec-05	1500	150	6.2	35.0	6.80	60.01			30.30	2.07																			17750
89	23-Dec-05	1500	150	6.3	35.0	6.98	61.86			30.30	2.07	4825	3299	2483	1.33															17750
90	24-Dec-05	1600	160	5.9	35.0	6.90				28.41	2.21																			17750
91	25-Dec-05	1600	160	5.9	35.0		64.20			28.41	2.21																			16500
																				16420										16500
	AVERAGE	1529	153	6.0	35.3	6.95	61.71	0.792	29.76	2.11	4863	3248	2957	1.27	52.7	34.6	2.0	0.7	16420			1671	760	305	17290	2975	2825	68.1	16500
																							1671	760	305	17290	2975	2825	68.1	17393
92	26-Dec-05	1600	160	6.2	34.0					28.41	2.21																			
93	27-Dec-05	1600	160	6.1	35.0	6.85	66.16			28.41	2.21	4552	3203	2270	1.40															16500
94	28-Dec-05	1600	160	6.2	35.0	6.90	63.05			28.41	2.21																			16500
95	29-Dec-05	1600	160	6.2	35.0	6.90	65.47			28.41	2.21																			16500
96	30-Dec-05	1600	160	6.3	35.0	6.84	60.43			28.41	2.21	4515	3360	2124	1.59	51.4	34.7	3.3	0.8											16500
97	31-Dec-05	1600	160	6.2	35.0	6.90	67.31			28.41	2.21																			16500
98	01-Jan-06	1600	160	6.2	35.0	7.00	66.10			28.41	2.21																			16500
																				17330										16500
	AVERAGE	1600	160	6.2	34.9	6.91	64.75	0.811	28.41	2.21	4534	3286	2291	1.50	51.4	34.7	3.3	0.8	17330				16500	3875	2425	70.9	16500
																							16500	3875	2425	70.9	16500
99	02-Jan-06	1600	160	6.4	35.0	6.94	59.50			28.41	2.21																			
100	03-Jan-06	1600	160	6.2	35.5	6.90	66.52			28.41	2.21					51.5	36.5	4.0	1.0											
101	04-Jan-06	1600	160	6.2	35.0	6.96	65.94			28.41	2.21	4379	3457	1925	1.80															16500
102	05-Jan-06	1600	160	6.2	35.0	6.90	63.95			28.41	2.21																			16500
103	06-Jan-06	1600	160	6.3	35.0	6.90	63.21			28.41	2.21																			16500
104	07-Jan-06	1600	160	6.9	35.0	6.87	65.25			28.41	2.21	4354	2490	1870	1.87	52.1	33.0	6.0	1.4											16500
105	08-Jan-06	1600	160	5.1	35.0	6.90	61.41			28.41	2.21																			16500
																				17570		7000								16500
	AVERAGE	1600	160	5.9	35.1	6.92	63.60	0.802	28.41	2.21	4367	2978	1890	1.84	51.8	34.8	5.0	1.2	17570		7000		16520	3800	3160	81.6	16500
																						7000		16520	3800	3160	81.6	16500		

TABLE B-10 MONITORING DATA FOR LABORATORY-SCALE REACTOR 07.0 (CONT'D)

DAY	DATE	INFLUENT	SUPL	INFLUENT	TEMP	BIOGAS	SP BIO METER:	SP BIO RATE	HRT	LOAD RATE	ALK	VA	BA	VA/BA	BIOGAS QUALITY CH4	CO2	N2	O2	COD	FILTER COD	BOD	FILTER BOD	TKN	NH3	TP	TS	TSS	VSS	VSS	SUPL COD
		mL	mL	pH	C	pH	L/d	L/d	d	g/d	mg/L	mg/L	mg/L		%	%	%	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	%	mg/L
36	31-Oct-85	1000	100	6.1	35.0	6.80	20.44		45.45	1.46					50.4	36.6	0.9	0.2												58490
37	01-Nov-85	1000	100	6.1	35.5	6.84	33.10		45.45	1.46	7517	6894	2622	2.63																58490
38	02-Nov-85	1000	100	6.1	38.0	6.83	36.54		45.45	1.46																				58490
39	03-Nov-85	1000	100	6.1	37.0	8.75	28.93		45.45	1.46																				58490
40	04-Nov-85	1000	100	6.1	36.5	6.90	30.40		45.45	1.46	7310	6523	2687	2.43																58490
41	05-Nov-85	1000	100	6.2	35.0	6.85	46.20		45.45	1.46																				58490
42	06-Nov-85	1000	100	6.1	35.0	6.82	41.53		45.45	1.46					52.1	34.4	2.4	0.6												58490
																			19190						21560	4175	2925	70.1	58490
	AVERAGE	1000	100	6.1	36.0	7.11	35.31	0.678	45.45	1.46	7418	6709	2655	2.53	51.3	35.5	1.7	0.4	19190						21560	4175	2925	70.1	58490
43	07-Nov-85	1000	100	6.2	35.0	6.80	36.75		45.45	1.46																				
44	08-Nov-85	1000	100	5.2	36.0	6.82	38.43		45.45	1.46	7331	6894	3604	2.02																58490
45	09-Nov-85	1000	100	6.2	33.0	6.81	33.71		45.45	1.46																				58490
46	10-Nov-85	1000	100	6.2	35.0	6.92	35.96		45.45	1.46																				58490
47	11-Nov-85	1100	110	6.2	34.0	6.80	41.00		41.32	1.61	6946	5634	2946	1.91																58490
48	12-Nov-85	1100	110	6.2	35.0	6.84	46.62		41.32	1.61																				58490
49	13-Nov-85	1100	110	5.7	36.0	6.87	53.65		41.32	1.61					54.0	35.5	3.0	0.8												58490
																			19980		6630		1720	950	441	20510	3825	3100	81.0	58490
	AVERAGE	1043	104	6.0	34.9	6.85	40.87	0.765	43.68	1.53	7139	5864	2975	1.97	54.0	35.5	3.0	0.8	19980		6630		1720	950	441	20510	3825	3100	81.0	58490
50	14-Nov-85	1100	110	6.2	35.0	6.92	53.45		41.32	1.61																				
51	15-Nov-85	1100	110	6.2	34.5	6.90	49.30		41.32	1.52	6847	5411	3005	1.80	52.4	36.0	3.1	0.8												58490
52	16-Nov-85	1100	110	6.2	34.0	6.95	48.14		41.32	1.52																				18780
53	17-Nov-85	1100	110	6.2	35.0	6.91	49.03		41.32	1.52																				18780
54	18-Nov-85	1100	110	6.7	35.0	6.93	49.14		41.32	1.52	6723	5048	3139	1.61																18780
55	19-Nov-85	1200	120	6.1	38.0	7.04	53.50		37.88	1.66																				18780
56	20-Nov-85	1200	120	6.1	36.5	7.04	61.64		37.88	1.66																				19470
																			19810						19890	2425			19470
	AVERAGE	1129	113	5.7	35.4	6.96	52.03	0.943	40.34	1.57	6785	5230	3072	1.71	52.4	36.0	3.1	0.8	19810						19890	2425			24650
57	21-Nov-85	1200	120	6.2	34.0	7.03	46.78		37.88	1.66					57.5	34.0	1.4	0.4												
58	22-Nov-85	1200	120	4.5	35.0	6.98	45.57		37.88	1.66	6376	4670	3660	1.55																19470
59	23-Nov-85	1200	120	4.5	35.0	6.99	54.86		37.88	1.66																				19470
60	24-Nov-85	1200	120	4.5	34.5	6.95	43.31		37.88	1.66																				19470
61	25-Nov-85	1200	120	6.2	34.5	6.90	41.74		37.88	1.66	5929	4603	3087	1.30																19470
62	26-Nov-85	1300	130	6.2	35.0	6.91	51.19		34.97	1.80																				19470
63	27-Nov-85	1300	130	6.2	35.0	6.85	56.20		34.97	1.80					49.3	35.3	6.7	1.7												19470
																			17410		4210		1780	857	370	19570	2825	2180	74.3	19470
	AVERAGE	1229	123	5.5	34.7	6.94	48.53	0.780	37.05	1.70	6153	4337	3074	1.42	53.4	34.7	4.1	1.1	17410		4210		1780	857	370	19570	2825	2180	74.3	19470
64	28-Nov-85	1300	130	6.2	35.0	6.85	51.08		34.97	1.89																				
65	29-Nov-85	1300	130	5.2	35.5	6.90	52.87		34.97	1.89	6072	4129	3940	1.05	54.3	36.9	0.7	0.2												54470
66	30-Nov-85	1300	130	6.1	35.0	6.80	50.43		34.97	1.89																				54470
67	01-Dec-85	0	0						0.00																					54470
68	02-Dec-85	1300	130	6.2	34.0	7.20			34.97	1.89	5332	2995	3486	0.88																54470
69	03-Dec-85	1300	130	6.2	35.0	6.93	39.69		34.97	1.89					55.4	34.7	0.9	0.2												54470
70	04-Dec-85	1300	130	6.2	36.0	7.00	50.51		34.97	1.89									17560						17950	3950	2750	69.6	54470
	AVERAGE	1114	111	6.0	35.1	6.96	50.52	0.890	34.97	1.62	6202	3562	3673	0.97	54.9	35.8	0.8	0.2	17560						17950	3950	2750	69.6	54470

TABLE D-10 MONITORING DATA FOR LABORATORY-SCALE REACTOR 07.0 (CONT'D)

DAY	DATE	WHEY mL	SUPL mL	WHEY pH	TEMP C	BIG pH	BIOGASPROD METER L/d	SP BIO RATE BUBL a3/kg COD UR	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	FILTER BOD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
106	09-Jan-86	1600	160	3.9	35.0	6.87	66.96		20.41	2.21					54.2	34.9	0.7	0.2												16500
107	10-Jan-86	1600	160	6.2	35.0	6.92	54.33		20.41	2.21	4341	3725	1696	2.20																16500
108	11-Jan-86	1600	160	6.2	35.0	5.89	65.38		20.41	2.21																				16500
109	12-Jan-86	1600	160	6.2	35.0	5.91	64.99		20.41	2.21																				16500
110	13-Jan-86	1600	160	6.3	35.0	6.86	64.40		20.41	2.21	4230	3175	1976	1.60																16500
111	14-Jan-86	1600	160	5.4	32.0	6.81	60.22		20.41	2.21					54.2	33.7	0.6	0.2												16500
112	15-Jan-86	1600	160	5.2		6.84	70.22		20.41	2.25									17650						14000	4356	3356	77.0	29040
	AVERAGE	1600	160	5.6	34.5	6.59	64.93	0.816	20.41	2.21	4286	3450	1836	1.90	54.2	34.3	0.7	0.2	17650						14000	4350	3350	77.0	18291
113	16-Jan-86	1600	160	4.9	36.0	6.87	79.43		20.41	2.25																				29040
114	17-Jan-86	1600	160	4.4	35.0	6.88	78.86		20.41	2.25	4217	3773	1538	2.45																29040
115	18-Jan-86	1600	160	6.1	35.0	6.91	82.78		20.41	2.25																				29040
116	19-Jan-86	1600	160	6.1	35.5	6.93	84.83		20.41	2.25																				29040
117	20-Jan-86	1600	160	6.0	35.0	6.92	80.48		20.41	2.25	4465	3711	1830	2.03	55.0	32.0	0.6	0.1												29040
118	21-Jan-86	1600	160	6.0	35.0	6.89	79.16		20.41	2.25																				29040
119	22-Jan-86	1600	160	6.1	34.0	6.82	74.84		20.41	2.25									16450		7000				13810	5650	4750	84.1	29040
	AVERAGE	1600	160	5.7	35.1	6.89	79.83	0.957	20.41	2.25	4341	3742	1684	2.24	55.0	32.0	0.6	0.1	16450		7000				13810	5650	4750	84.1	29040
120	23-Jan-86	1600	160	6.4	34.0	6.78	70.62		20.41	2.25					54.1	33.4	0.5	0.1												29040
121	24-Jan-86	1600	160	6.3	34.5	6.83	73.36		20.41	2.25	4329	3505	1841	1.90																29040
122	25-Jan-86	1600	160	6.4	36.0	6.90	76.41		20.41	2.25																				29040
123	26-Jan-86	1600	160	6.4	33.0	6.90	71.12		20.41	2.25																				29040
124	27-Jan-86	1600	160	6.3	34.0	6.90	70.66		20.41	2.25	4215	3306	1868	1.77	55.7	35.6	0.7	0.2												29040
125	28-Jan-86	1700	170	6.3	33.0	6.90	70.95		26.74	2.39																				29040
126	29-Jan-86	1700	170	6.3	33.0	6.84	72.43		26.74	2.39									17460						14330	5950	5100	85.7	29040
	AVERAGE	1629	163	6.3	34.5	6.86	72.14	0.868	27.93	2.29	4272	3486	1855	1.84	54.9	34.5	0.6	0.2	17460						14330	5950	5100	85.7	29040
127	30-Jan-86	1700	170	6.3	35.0	6.84	80.09		26.74	2.39																				29040
128	31-Jan-86	1700	170	6.5	35.0	6.81	72.33		26.74	2.39	4002	3244	1699	1.91	56.3	34.5	1.5	0.4												29040
129	01-Feb-86	1700	170	6.2	35.0	6.84	71.82		26.74	2.39																				29040
130	02-Feb-86	1700	170	6.2	32.0	6.86	66.34		26.74	2.39																				29040
131	03-Feb-86	1700	170	6.1	35.0	6.80	69.70		26.74	2.39	3844	3189	1588	2.02	55.4	36.7	0.7	0.2												29040
132	04-Feb-86	1700	170	6.2	35.0	6.82	72.47		26.74	2.39																				29040
133	05-Feb-86	1700	170		35.0		76.84		26.74	2.39									17666	6246	6300	3660			16500	7750	6450	83.2	29040
	AVERAGE	1700	170	5.9	34.6	6.83	72.68	0.842	26.74	2.39	3923	3217	1640	1.97	55.9	35.6	1.1	0.3	17666	6246	6300	3660			16500	7750	6450	83.2	29040
134	06-Feb-86	1700	170	6.2	34.5	6.90	75.18		26.74	2.39					57.5	35.5	3.2	0.8												29040
135	07-Feb-86	1700	170	6.0	34.0	6.81	66.12		26.74	2.39	3887	3251	1499	2.17																29040
136	08-Feb-86	1700	170	6.3	35.0	6.79	71.87		26.74	2.39																				29040
137	09-Feb-86	1700	170	6.3	35.0	6.80	73.33		26.74	2.39																				29040
138	10-Feb-86	1700	170	6.2	34.0	6.82	71.17		26.74	2.39	3760	3079	1574	1.96	54.1	32.8	4.1	1.1												29040
139	11-Feb-86	1700	170	6.2	35.0	6.78	60.51		26.74	2.39																				29040
140	12-Feb-86	1700	170	6.4	34.5	6.78	67.91		26.74	2.39									18060						16740	10500	9200	87.6	29040
	AVERAGE	1700	170	5.9	34.6	6.81	70.38	0.825	26.74	2.39	3704	3165	1537	2.07	55.8	34.2	3.7	1.0	18060	ERR	ERR	ERR			16740	10500	9200	87.6	29040

TABLE B-18 MONITORING DATA FOR LABORATORY-SCALE REACTOR 07.0 (CONT'D)

DAY	DATE	WWEY mL	SUPL mL	WWEY pH	TEMP C	BIO pH	BIOGAS METER L/d	SP BIO GASPROD BUBL L/d	RATE m3/kg COD UR	HRT d	LOAD RATE g/d	ALK eq/L	VA eq/L	BA eq/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	H2 %	O2 %	FILTER COD eq/L	FILTER COD eq/L	BOD eq/L	FILTER BOD eq/L	TKN eq/L	NH3 eq/L	TP eq/L	TS eq/L	TSS eq/L	VSS eq/L	VSS %	SUPL COD eq/L
141	13-Feb-86	1700	170	5.7	34.0	6.77	69.81			26.74	2.39					55.4	34.6	1.6	0.4												29040
142	14-Feb-86	1700	170	4.9	36.0	6.80	74.69			26.74	2.39	3872	3025	1724	1.75																29040
143	15-Feb-86	1700	170	6.3	35.0	6.81	76.31			26.74	2.39																				29040
144	16-Feb-86	1700	170	6.3	35.0	6.80	78.14			26.74	2.39																				29040
145	17-Feb-86	1700	170	6.3	36.0	6.80	74.16			26.74	2.39	3826	2942	1737	1.69	55.5	34.3	0.6	0.2												29040
146	18-Feb-86	1700	170		36.0		80.11			26.74	2.39																				29040
147	19-Feb-86	1700	170		35.0		80.49			26.74	2.39									18140	5680	4660	3700				19500	10500	9250	88.1	29040
	AVERAGE	1700	170	5.9	35.3	6.80	76.24	0.093	26.74	2.39	3849	2984	1731	1.72		55.5	34.5	1.1	0.3	18140	5680	4660	3700				19500	10500	9250	88.1	29040
148	20-Feb-86	0	0		34.0	6.90	80.15			0.00						57.7	30.7	0.7	0.2												31590
149	21-Feb-86	1700	170	6.4	34.0	7.24	48.63			26.74	2.40	4096	1814	2080	0.65																31590
150	22-Feb-86	1700	170	6.4	34.0	7.00	63.70			26.74	2.40																				31590
151	23-Feb-86	1700	170	6.4	35.0	7.07	72.84			26.74	2.40																				31590
152	24-Feb-86	1700	170	6.2	36.0	6.98	67.07			26.74	2.40	3920	1871	2592	0.72	56.2	34.5	2.4	0.6												31590
153	25-Feb-86	1000	100	6.0	35.0	6.97	74.52			25.25	2.54																				31590
154	26-Feb-86	1000	100	6.1	35.0	6.90	71.87			25.25	2.54									16820							14100	11150	9900	88.8	31590
	AVERAGE	1486	149	6.3	34.7	7.03	68.28	0.940	26.24	2.49	4008	1843	2780	0.69		57.0	32.6	1.6	0.4	16820	ERR	ERR	ERR				14100	11150	9900	88.8	31590
155	27-Feb-86	1000	100	6.3	34.0	6.90	70.38			25.25	2.54					54.8	34.9	0.7	0.2												31590
156	28-Feb-86	1000	100	5.7	35.0	6.95	75.46			25.25	2.54	3770	2347	2104	1.12																31590
157	01-Mar-86	1000	100	6.1	36.0	6.97	77.67			25.25	2.54																				31590
158	02-Mar-86	1000	100	6.1	36.0	6.95	78.33			25.25	2.54																				31590
159	03-Mar-86	1000	100	6.0	35.0	6.93	78.16			25.25	2.54	3723	2362	2046	1.15	56.1	32.5	3.1	0.8												31590
160	04-Mar-86	1900	190	6.2	35.0	6.92	74.19			23.92	2.68																				31590
161	05-Mar-86	1900	190	6.3	34.0	6.90	75.02			23.92	2.68									18080	4450	4950	2110				15760	11850	10450	88.2	31590
	AVERAGE	1829	183	6.1	35.0	6.94	76.74	0.830	24.87	2.58	3747	2355	2075	1.14		55.5	33.7	1.9	0.5	18080	4450	4950	2110				15760	11850	10450	88.2	31590
162	06-Mar-86	1900	190	6.3	35.0	6.89	78.27			23.92	2.68					53.1	31.7	5.1	1.3												31590
163	07-Mar-86	1900	190	6.0	34.0	6.88				23.92	2.68	3602	2472	1847	1.34																31590
164	08-Mar-86	1900	190	6.0	35.0	6.88	75.32			23.92	2.68																				31590
165	09-Mar-86	1900	190	6.0	35.0	6.81	75.19			23.92	2.68																				31590
166	10-Mar-86	1900	190	6.3	36.0	6.82	81.77			23.92	2.68	3491	2641	1616	1.63	54.1	32.4	4.9	1.2												31590
167	11-Mar-86	1900	190	6.0	35.0	6.81	87.94			23.92	2.68																				31590
168	12-Mar-86	1900	190	6.1	35.0	6.79	74.42			23.92	2.68									18320							16900	12300	10850	88.2	31590
	AVERAGE	1900	190	6.1	35.0	6.84	78.82	0.825	23.92	2.68	3547	2557	1732	1.49		53.6	32.1	5.0	1.3	18320	ERR	ERR	ERR				16900	12300	10850	88.2	31590
169	13-Mar-86	1900	190	6.1	35.0	6.72	77.86			23.92	2.68					51.6	32.1	4.5	1.2												31590
170	14-Mar-86	1900	190	6.2	36.0	6.70	73.77			23.92	2.68	3416	2937	1317	2.25																31590
171	15-Mar-86	1000	100	6.2	36.0	6.73	79.64			25.25	2.54																				31590
172	16-Mar-86	1000	100	6.2	35.0	6.78	65.23			25.25	2.54																				31590
173	17-Mar-86	1000	100	6.0	35.0	6.74	65.05			25.25	2.54	3206	2591	1446	1.79	52.9	31.4	5.7	1.5												31590
174	18-Mar-86	1000	100	6.2	36.0	6.79	67.25			25.25	2.54																				31590
175	19-Mar-86	1000	100	5.3	35.0	6.80	76.38			25.25	2.54									18750	4730	5700	3040				15000	12500	11000	88.0	31590
	AVERAGE	1829	183	6.0	35.4	6.75	72.17	0.792	24.87	2.58	3351	2774	1382	2.02		52.3	31.8	5.1	1.4	18750	4730	5700	3040				15000	12500	11000	88.0	31590

TABLE B-10 MONITORING DATA FOR LABORATORY-SCALE REACTOR 07.0 (CONT'D)

Day	Date	WHEY mL	SUPL mL	WHEY pH	TEMP C	DIG pH	BIOGAS METER L/d	SP BIO GAS PROD RATE BUBL L/d	SP BIO GAS RATE m3/kg COD	HRT d	LOAD RATE g/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	FILTER BOD mg/L	BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	VSS %	SUPL COD mg/L
176	20-Mar-86	1000	100	6.2	35.0	6.80	64.10			25.25	2.54																			
177	21-Mar-86	1000	100	6.0	35.0	6.70	62.21			25.25	2.54					53.6	30.0	6.3	1.6											31590
178	22-Mar-86	1000	100	6.0	35.0	6.75	63.75			25.25	2.54	3295	2496	1523	1.64															31590
179	23-Mar-86	1000	100	6.0	35.0	6.78	60.85			25.25	2.54																			31590
180	24-Mar-86	1000	100	6.0	36.0	6.80	65.11			25.25	2.54																			31590
181	25-Mar-86	1000	100	6.2	35.0	6.81	66.42			25.25	2.54	3250	2204	1636	1.40	57.1	32.5	5.1	1.3											31590
182	26-Mar-86	1000	100	6.2	35.0	6.85	73.91			25.25	2.54																			31590
																				16087						15600	12500	11400	91.2	31590
	AVERAGE	1000	100	6.1	35.1	6.78	66.33	0.710	25.25	2.54		3277	2390	1580	1.52	55.4	31.7	5.7	1.5	16087						15600	12500	11400	91.2	31590

APPENDIX C

COPY OF FULL SCALE DIGESTER DATA

TABLE C-1 MONITORING DATA FOR THE FULL-SCALE DIGESTER

DAY	DATE	INFV IGPD	SUPL IGAL	INFV pH	TEMP C	DIG pH	BIOGAS PROD '000 ft3	SP.BIO PROD RATE m3/m3	HRT d	LOAD RATE kg/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA mg/L	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	FILTER BOD mg/L	BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	%VSS	SUPL COD mg/L
1	12-Sep-05																													
2	13-Sep-05																													
3	14-Sep-05																													
4	15-Sep-05																													
5	16-Sep-05										12992	5404	8235	0.65																
6	17-Sep-05																									29490	11100	8250	74.4	
7	18-Sep-05			6.2	35.5	7.40	3126	16.0																						
	AVERAGE			6.2	35.5	7.40		16.0			12992	5404	8235	0.65												29490	11100	8250	74.4	
8	19-Sep-05			6.1	36.0	7.50	3142	16.0																						
9	20-Sep-05			6.1	35.0	7.40	3158																							
10	21-Sep-05																													
11	22-Sep-05																													
12	23-Sep-05			6.2	35.0	7.35	3206	18.0											16180											
13	24-Sep-05			6.2	35.5	7.35	3224	18.0																						
14	25-Sep-05	4000	0	6.2	35.5	7.45	3242	22.0		62.50	1.00	10516	3499	8032	0.44															
	AVERAGE	4000	0	6.2	35.4	7.45		18.5	0.429	62.50	1.00	10516	3499	8032	0.44				16180											
15	26-Sep-05	4000	0	3.4	35.0	7.50	3264	15.0		62.50	1.00																			
16	27-Sep-05	4000	0	3.5	35.0	7.60	3279	17.0		62.50	1.00																			
17	28-Sep-05	4000	0				3296	11.0		62.50	1.00																			
18	29-Sep-05	2000	0				3307	12.0		125.00	0.54																			
19	30-Sep-05	3000	4200	6.1	35.0	7.41	3319	19.0		34.72	0.80	10322	4470	7143	0.63															10350
20	01-Oct-05	0	0	4.2	35.0	7.60	3338	17.0			0.00																			
21	02-Oct-05	4000	0	3.4	34.0	7.63	3355	19.0		62.50	1.00								17490		7490		1947	1153	490					
	AVERAGE	3000	600	4.1	34.8	7.55		15.7	0.400	68.29	0.82	10322	4470	7143	0.63				17490		7490		1947	1153	490					10350
22	03-Oct-05	4000	0	3.4	35.5	7.48	3374	19.0		62.50	1.00					57.0	36.0	1.0	0.3											
23	04-Oct-05	4000	0	6.3	35.0	7.49	3393	18.0		62.50	1.00	10711	4031	7809	0.52															
24	05-Oct-05	2500	0				3411	14.0		100.00	0.67																			
25	06-Oct-05	4000	0				3425	6.0		62.50	1.00																			
26	07-Oct-05	4300	0	6.1	34.0	7.48	3431	22.0		58.14	1.16	9644	3762	6935	0.54															
27	08-Oct-05	3000	0	6.1	35.5	7.50	3453	19.0		83.33	0.81																			
28	09-Oct-05	3000	0	6.1	35.0	7.49	3472	18.0		83.33	0.81								17390											
	AVERAGE	3543	0	5.6	35.4	7.49		16.6	0.434	73.19	0.95	10178	3897	7372	0.53	57.0	36.0	1.0	0.3	17390										
29	10-Oct-05	4300	0	4.3	35.0	7.45	3490	22.0		58.14	1.16																			
30	11-Oct-05	4000	0	4.3	34.0	7.43	3512	22.0		62.50	1.00	9920	4185	6964	0.59															
31	12-Oct-05	4000	0				3534	16.0		62.50	1.00																			
32	13-Oct-05	4000	0				3550	19.0		62.50	1.00																			
33	14-Oct-05	5000	0	4.3	35.0	7.40	3569	19.0		50.00	1.35																			
34	15-Oct-05	5000	0	3.8	35.5	7.38	3588	22.0		50.00	1.35	8865	4380	5769	0.75	49.5	44.7	0.7	0.2											
35	16-Oct-05	5000	0	3.8	35.0	7.41	3610	24.0		50.00	1.35								17090		7200		1700	827	545	22870	9175	5175	56.4	

TABLE C-I MONITORING DATA FOR THE FULL-SCALE DIGESTER (CONT'D)

DAY	DATE	INFV IGPD	SUPL IGAL	INFV pH	TEMP C	DIG pH	BIOGAS m3	PROD '000 ft3	SP.BIO PROD RATE m3/m3	HRT d	LOAD RATE kg/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA mg/L	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	BOD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	IVSS	SUPL COD mg/L
36	17-Oct-85	5000	0	4.4	35.0	7.45	3634	24.0		50.00	1.35																			
37	18-Oct-85	4000	0	5.0	35.5	7.25	3650	19.0		62.50	1.08	8451	4648	5184	0.91															
38	19-Oct-85	4000	0	5.0			3677	16.0		62.50	1.08																			
39	20-Oct-85	1500	0	5.0			3693	16.0		166.67	0.40																			
40	21-Oct-85	4000	0	6.2	34.5	7.50	3709	25.0		62.50	1.08	8335	4552	5050	0.90															
41	22-Oct-85	4000	0	3.6	35.5	7.10	3734	24.0		62.50	1.08					52.9	32.1	2.6	0.7											
42	23-Oct-85	3500	0	5.9	35.5	7.20	3758	21.0		71.43	0.94									15000						23970	6600	4525	68.6	
	AVERAGE	3714	0	5.0	35.2	7.32		20.7	0.517	76.87	1.00	8393	4600	5001	0.91	52.9	32.1	2.6	0.7	15000						23970	6600	4525	68.6	
43	24-Oct-85	5000	0	6.2	35.5	7.10	3779	18.0		50.00	1.35																			
44	25-Oct-85	2000	4200	6.1	35.0	7.00	3797	0.0		40.32	0.75	7926	6976	2983	2.40															58490
45	26-Oct-85	3000	0	6.2			3797	0.0		83.33	0.81																			
46	27-Oct-85	4000	0	6.2			3797	0.0		52.00	1.29																			
47	28-Oct-85	5000	0	6.2	35.0	7.35	3797	0.0		50.00	1.35	7939	4300	4086	0.80	54.0	32.5	5.2	1.4											
48	29-Oct-85	4000	0	6.2	35.0	7.30	3797	0.0		62.50	1.00																			
49	30-Oct-85	4100	0	6.2	35.0	7.15	3797	0.0		60.98	1.10									18090		5080		1753	957	995	28530	9050	5100	56.4	
	AVERAGE	3986	600	6.2	35.1	7.10		2.6	0.050	57.03	1.10	7933	5630	3895	1.64	54.0	32.5	5.2	1.4	18090		5080		1753	957	995	28530	9050	5100	56.4	58490
50	31-Oct-85	4000	0	6.1	35.0	7.00	3797	0.0		62.50	1.08					49.0	41.4	1.0	0.3											
51	01-Nov-85	3000	0	6.1	35.0	7.10	3797	0.0		83.33	0.81	7442	4188	4468	0.94															
52	02-Nov-85	1000	0	6.1			3797	0.0		138.89	0.48																			
53	03-Nov-85	1500	0	6.1			3797	0.0		166.67	0.40																			
54	04-Nov-85	3000	0	6.1	34.0	7.35	3797	0.0		50.00	1.35	7318	3521	4010	0.73	57.3	32.6	3.5	0.9											
55	05-Nov-85	5200	0	6.2	34.0	7.20	3797	0.0		48.00	1.40																			
56	06-Nov-85	5300	0	6.1	35.0	7.10	3797	0.0		47.17	1.43									17620						23130	7000	5475	70.2	
	AVERAGE	3686	0	6.1	34.6	7.15		0.0	0.000	85.23	0.99	7380	3855	4443	0.84	53.6	37.0	2.3	0.6	17620						23130	7000	5475	70.2	
57	07-Nov-85	3500	0	6.2	35.5	7.10	3797	0.0		45.45	1.48																			
58	08-Nov-85	0	0	5.2	35.5	7.05	3797	0.0			0.00	6996	4448	3838	1.16															
59	09-Nov-85	3500	0	6.2	35.0	7.05	3797	0.0		71.43	0.94																			
60	10-Nov-85	3200	0	6.2	34.5	7.10	3797	0.0		78.13	0.86																			
61	11-Nov-85	4000	0	6.2	34.5	7.10	3797	0.0		52.00	1.29	6946	4405	3762	1.19	49.9	39.9	3.9	1.0											
62	12-Nov-85	4300	0	6.2	34.0	6.90	3797	0.0		58.14	1.16																			
63	13-Nov-85	2200	0	5.7	34.5	6.90	3797	0.0		113.64	0.59									18580		5560		1670	810	560	22970	8975	5975	66.6	
	AVERAGE	3357	0	6.0	34.8	7.03		0.0	0.000	69.81	0.90	6971	4467	3800	1.10	49.9	39.9	3.9	1.0	18580		5560		1670	810	560	22970	8975	5975	66.6	
64	14-Nov-85	2500	0	6.2	35.5	6.95	3797	0.0		100.00	0.67					48.2	36.5	5.3	1.4											
65	15-Nov-85	2300	4200	6.2	35.5	7.07	3797	0.0		38.46	0.69	7753	4539	4516	1.01															18780
66	16-Nov-85	2600	0	6.2	35.5	7.10	3797	0.0		125.00	0.54																			
67	17-Nov-85	2600	0	6.2	35.5	7.20	3797	0.0		125.00	0.54																			
68	18-Nov-85	5400	0	4.7	34.5	7.20	3797	0.0		46.30	1.45	6735	3973	3911	1.02															
69	19-Nov-85	2800	4200	6.1	34.5	7.00	3797	0.0		35.71	0.83																			19470
70	20-Nov-85	5700	0	4.1	34.5	7.10	3797	6.0		43.86	1.33									17960						21150	4800			
	AVERAGE	3243	1200	5.7	35.1	7.09		0.9	0.024	73.48	0.89	7244	4266	4214	1.02	48.2	36.5	5.3	1.4	17960						21150	4800			19125

TABLE C-I MONITORING DATA FOR THE FULL-SCALE DIGESTER (CONT'D)

DAY	DATE	WHEY IBPD	SUPL IBAL	WHEY pH	TEMP C	DIG pH	BIOGAS m3	SP.BIO PROD '000 ft3	SP.BIO PROD RATE m3/m3	HRT d	LOAD RATE kg/d	ALK eq/L	VA eq/L	BA eq/L	VA/BA eq/L	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD eq/L	FILTER COD eq/L	FILTER BOD eq/L	BOD eq/L	TKN eq/L	NH3 eq/L	TP eq/L	TS eq/L	TSS eq/L	VSS eq/L	IVSS	SUPL COD eq/L
71	21-Nov-85	5100	0	6.2	35.0	7.05	3803	29.0		49.02	1.37					49.7	42.3	1.3	0.3												
72	22-Nov-85	3500	0	6.5	35.0	7.10	3832	32.0		71.43	0.94	6487	4803	3645	1.10																
73	23-Nov-85	4000	0	6.3	36.0	7.03	3864	24.0		62.50	1.00																				
74	24-Nov-85	0	0	6.5	35.0	7.15	3888	17.0			0.00																				
75	25-Nov-85	4900	0	6.2	35.0	7.15	3905	29.0		51.02	1.32	6165	3514	3670	0.96	57.0	29.9	4.0	1.0												
76	26-Nov-85	4900	0	6.2	34.5	7.00	3934	30.0		51.02	1.32																				
77	27-Nov-85	4900	0	6.2	35.0	7.00	3964	31.0		51.02	1.32									17000		4010		1714	820	520	21510	5300	3650	68.9	
	AVERAGE	3900	0	5.5	35.1	7.07		27.4	0.652	56.00	1.05	6326	3759	3650	1.03	53.4	36.1	2.7	0.7	17000		4010		1714	820	525	21510	5300	3650	68.9	
78	28-Nov-85	5000	0	6.2	35.0	6.90	3995	29.0		50.00	1.35																				
79	29-Nov-85	3200	4200	5.2	35.0	7.00	4024	21.0		26.60	1.40	5830	3996	2993	1.34	44.2	44.9	4.0	1.1												54470
80	30-Nov-85	1500	0	6.1	35.0	6.95	4045	20.0		166.67	0.40																				
81	01-Dec-85	0	0				4065	23.0			0.00																				
82	02-Dec-85	5400	0	6.2	34.0	7.15	4088	23.0		46.30	1.45	5760	3469	3305	1.05																
83	03-Dec-85	5200	0	6.2	34.0	6.90	4111	29.0		48.08	1.40					55.7	41.5	0.7	0.2												
84	04-Dec-85	4200	0	6.2	34.0	6.90	4140	29.0		59.52	1.13									18510						20100	6400	4275	66.8		
	AVERAGE	3786	600	6.0	34.5	6.97		24.9	0.669	66.19	1.02	5799	3733	3149	1.20	50.0	43.2	2.4	0.7	18510						20100	6400	4275	66.8	54470
85	05-Dec-85	5400	0	5.4	34.0	6.90	4169	31.0		46.30	1.45					49.3	45.0	0.9	0.2												
86	06-Dec-85	3900	0	4.7	34.5	6.85	4200	30.0		64.10	1.05	5656	4225	2656	1.59																
87	07-Dec-85	4100	0	4.7	34.5	6.83	4230	25.0		60.90	1.10																				
88	08-Dec-85	0	0	4.5	34.0	6.95	4255	16.0			0.00																				
89	09-Dec-85	5000	0	6.1	34.5	7.00	4271	21.0		50.00	1.35	5339	3855	2622	1.47	56.0	33.5	3.1	0.8												
90	10-Dec-85	5000	0	6.2	34.0	6.95	4292	24.0		50.00	1.35																				
91	11-Dec-85	2300	4200	6.2	34.5	6.78	4316	28.0		30.46	0.68									18350		5660		1671	765	590	28360	7800	4900	62.8	17200
	AVERAGE	3671	600	5.4	34.2	6.89		23.9	0.597	51.64	1.00	5508	4040	2639	1.53	52.7	39.3	2.0	0.5	18330		5660		1671	765	595	28360	7800	4900	62.8	17200
92	12-Dec-85	0	0	6.2	34.5	7.02	4336	18.0			0.00																				
93	13-Dec-85	3500	0	6.2	34.0	7.22	4354	23.0		71.43	0.94	5569	3447	3122	1.10																
94	14-Dec-85	3300	0	6.2	34.5	7.05	4377	22.0		75.76	0.89																				
95	15-Dec-85	0	0	6.2	34.0	7.05	4399	14.0			0.00																				
96	16-Dec-85	4500	0	6.2	34.0	7.00	4413	24.0		55.56	1.21	5982	3277	3235	1.01	55.0	34.4	3.6	0.9												
97	17-Dec-85	5500	0	6.2	34.5	7.00	4437	27.0		45.45	1.48																				
98	18-Dec-85	5500	0	6.4	34.0	6.90	4464	28.0		45.45	1.48									17890						17750	6300	4450	70.6		
	AVERAGE	3186	0	6.2	34.2	7.05		22.3	0.649	58.73	0.84	5576	3362	3189	1.06	55.0	34.4	3.6	0.9	17890						17750	6300	4450	70.6	
99	19-Dec-85	5500	4200	5.7	33.5	6.82	4492	29.0		25.77	1.35																				
100	20-Dec-85	5500	0	5.9	33.5	6.82	4521	29.0		45.45	1.48	5284	3945	2483	1.59	42.7	44.2	4.3	1.1												17750
101	21-Dec-85	4700	0	6.2	34.0	6.73	4550	30.0		53.19	1.27																				
102	22-Dec-85	0	0	6.2	34.0	6.83	4580	18.0			0.00																				
103	23-Dec-85	4800	0	6.3	34.0	7.03	4598	26.0		52.08	1.29	5160	3911	2383	1.64																
104	24-Dec-85	4500	4200	5.9	34.5	7.00	4624	23.0		28.74	1.27																				
105	25-Dec-85	4500	0	5.9			4647	25.0		55.56	1.21					52.5	37.3	3.2	0.0	18700		6660		1686	770	580	29120	3675	1850	60.2	16500
	AVERAGE	4214	1200	6.0	33.9	6.87		25.7	0.557	43.47	1.15	5222	3920	2433	1.62	47.6	40.8	3.8	1.0	18700		6660		1686	770	580	29120	3675	1850	60.2	17125

TABLE C-1 MONITORING DATA FOR THE FULL-SCALE DIGESTOR (CONT'D)

DAY	DATE	INFV IBPD	SUPL IBAL	INFV pH	TEMP C	DIG pH	BIOGAS m3	PROD *000 ft3	SP.BIO PROD RATE m3/m3	HRT d	LOAD RATE kg/d	ALK eq/L	VA eq/L	BA eq/L	VA/BA eq/L	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD eq/L	FILTER COD eq/L	BOD eq/L	FILTER BOD eq/L	TKN eq/L	NH3 eq/L	TP eq/L	TS eq/L	TSS eq/L	VSS eq/L	IVSS	SUPL COD eq/L
106	26-Dec-85	3000	0	6.2			4472	25.0		65.79	1.02																			
107	27-Dec-85	2700	0	6.1	34.0	6.97	4497	26.0		92.59	0.73	4483	3656	1887	2.02															
108	28-Dec-85	3700	0	6.2	33.5	6.90	4723	22.0		67.57	1.00																			
109	29-Dec-85	0	0	6.2	33.0	6.99	4745	16.0			0.00																			
110	30-Dec-85	3000	0	6.3	33.0	7.09	4761	25.0		65.79	1.02	5856	3323	2677	1.24	58.6	31.5	3.9	1.0											
111	31-Dec-85	1600	0	6.2			4786	21.0		156.25	0.43																			
112	01-Jan-86	0	0	5.4	34.0	7.29	4807	11.0			0.00									18150						19360	6150	4225	68.7	
	AVERAGE	2229	0	6.1	33.5	7.03		20.9	0.860	89.60	0.60	4720	3490	2242	1.63	58.6	31.5	3.9	1.0	18150						19360	6150	4225	68.7	
113	02-Jan-86	2900	0	6.0	34.5	7.25	4818	17.0		86.21	0.78					58.1	31.7	4.3	1.1											
114	03-Jan-86	3700	0	6.1	34.0	7.20	4835	23.0		67.57	1.00	5135	2894	3060	0.94															
115	04-Jan-86	3600	0	5.2	33.5	7.15	4858	21.0		69.44	0.97																			
116	05-Jan-86	0	0		33.0	7.12	4879	13.0			0.00																			
117	06-Jan-86	3500	0	6.1	33.0	7.10	4892	22.0		45.45	1.48	5824	2887	2974	0.97	51.3	34.6	6.5	1.7											
118	07-Jan-86	3600	0	5.9	33.5	7.05	4914	23.0		44.64	1.51																			
119	08-Jan-86	3500	0	6.2	34.0	6.95	4937	29.0		45.45	1.48									16680		5980				18860	5475	3975	72.6	
	AVERAGE	3829	0	5.9	33.6	7.12		21.1	0.512	59.80	1.03	5080	2891	3027	0.96	54.7	33.2	5.4	1.4	16680		5980				18860	5475	3975	72.6	
120	09-Jan-86	3000	4200	6.3	35.0	6.95	4966	25.0		34.72	0.87					36.7	47.0	6.5	1.7											17150
121	10-Jan-86	0	0		35.0	6.95	4991	2.0			0.00	4565	3602	2008	1.79															
122	11-Jan-86	0	0		34.5	7.01	4993	1.0			0.00																			
123	12-Jan-86	0	0		34.5	7.21	4994	9.0			0.00																			
124	13-Jan-86	2300	0	6.3	34.5	7.35	5003	16.0		100.70	0.62	4850	2777	2878	0.96															
125	14-Jan-86	3400	0	5.4	34.5	7.32	5019	16.0		73.33	0.92					54.5	35.4	4.6	1.2											
126	15-Jan-86	3700	0	5.9	34.0	7.33	5035	20.0		67.57	1.00									17110						17350	3850	2500	64.9	
	AVERAGE	1771	600	6.0	34.6	7.16		12.7	0.653	71.13	0.49	4708	3190	2443	1.38	45.6	41.2	5.6	1.5	17110						17350	3850	2500	64.9	17150
127	16-Jan-86	0	0		33.5	7.23	5035	6.0			0.00																			
128	17-Jan-86	0	0		33.0	7.00	5041	0.0			0.00	4464	3505	2176	1.61															
129	18-Jan-86	0	0		33.0	7.02	5041	0.0			0.00																			
130	19-Jan-86	0	0		33.0	7.03	5041	1.0			0.00																			
131	20-Jan-86	0	0		32.5	7.04	5042	1.0			0.00	4402	2900	2543	1.14	43.1	42.1	5.8	1.0											
132	21-Jan-86	0	0		32.0	7.15	5043	1.0			0.00																			
133	22-Jan-86	2500	0	6.3	31.0	7.10	5044	13.0		100.00	0.67									15350		3850				16850	3600	2800	77.8	
	AVERAGE	357	0	6.3	32.6	7.08		3.1	0.017	100.00	0.10	4633	3203	2360	1.30	43.1	42.1	5.8	1.0	15350		3850				16850	3600	2800	77.8	
134	23-Jan-86	2000	8400	6.1	31.0	7.11	5077	13.0		24.84	0.55					58.6	33.8	6.9	1.0											1709
135	24-Jan-86	3600	0	6.2	31.0	7.01	5090	12.0		83.33	0.81	4469	2674	2571	1.04															
136	25-Jan-86	3600	0	5.1	31.0	6.95	5102	12.0		69.44	0.97																			
137	26-Jan-86	0	0		31.0	6.90	5114	2.0			0.00																			
138	27-Jan-86	3600	0	6.2	31.0	6.95	5116	15.0		83.33	0.81	4469	2866	2434	1.18	49.4	39.6	6.1	1.1											
139	28-Jan-86	3600	0	6.0	32.0	6.90	5131	16.0		83.33	0.81																			
140	29-Jan-86	1600	0	6.4	32.0	7.00	5147	9.0		250.00	0.27									16220						15810	4900	3350	68.4	
	AVERAGE	2229	1200	6.0	31.3	6.97		11.3	0.460	98.91	0.60	4469	2770	2503	1.11	50.0	36.7	5.5	1.5	16220						15810	4900	3350	68.4	1709

TABLE C-1 MONITORING DATA FOR THE FULL-SCALE DIGESTER (CONT'D)

DAY	DATE	INFD	SUPL	INFD	TEMP	DIG	BIOGAS	PROD	SP.BIO PROD	HRT	LOAD	ALK	VA	BA	VA/BA	BIOGAS QUALITY				FILTER	FILTER							SUPL
		IBFD	IBAL	pH	C	pH	m3	'000	RATE	d	RATE	eq/L	eq/L	eq/L	eq/L	CH4	CO2	N2	O2	COD	COD	BOD	BOD	TKN	NH3	TP	TS	TSS	VSS	IVSS	COD
								ft3	m3/m3		kg/d					%	%	%	%	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L		eq/L
141	30-Jan-86	1500	0400	5.9	33.0	7.05	5156	16.0		25.25	0.41					48.1	37.4	7.2	1.7											
142	31-Jan-86	2500	0	5.8	32.0	6.90	5172	19.0		100.00	0.67	4319	2681	2416	1.11															1510
143	01-Feb-86	2600	0	6.1	33.0	7.00	5191	19.0		96.15	0.70																			
144	02-Feb-86	0	0				5210	14.0			0.00																			
145	03-Feb-86	3500	0	6.1	33.0	7.35	5224	10.0		45.45	1.48	4109	2250	2379	1.07	54.4	39.5	3.1	0.0											
146	04-Feb-86	3000	0	6.2	33.5	6.91	5242	24.0		83.33	0.81																			
147	05-Feb-86	2500	0		33.5		5266	14.0		100.00	0.67									15500	7140	4260	3180				16150	5650	3800	67.3	
	AVERAGE	2514	1200	6.0	33.0	7.04		17.7	0.652	75.03	0.68	4234	2616	2398	1.09	51.3	38.5	5.2	1.3	15500	7140	4260	3180				16150	5650	3800	67.3	1510
148	06-Feb-86	0	0400		34.0	7.12	5280	15.0		29.76	0.01					48.3	39.3	3.4	0.9											
149	07-Feb-86	3000	0	4.0	34.0	7.02	5295	29.0		50.00	1.33	4142	2606	2434	0.99															1695
150	08-Feb-86	3400	0				5324	20.0		73.53	0.92																			
151	09-Feb-86	0	0				5344	15.0			0.00																			
152	10-Feb-86	4500	0	6.2	34.5	7.05	5359	12.0		55.56	1.21	4021	2439	2289	1.07	53.1	33.1	4.7	1.2											
153	11-Feb-86	2500	0	6.2	34.5	6.90	5371	22.0		100.00	0.67																			
154	12-Feb-86	2000	0	6.4	34.5	6.92	5393	28.0		125.00	0.54									14000							16490	5900	4150	70.3	
	AVERAGE	2486	1200	5.7	34.3	7.00		19.0	0.707	72.31	0.67	4082	2423	2362	1.03	50.7	36.2	4.1	1.1	14000							16490	5900	4150	70.3	1695
155	13-Feb-86	2000	4200	5.7	34.5	6.89	5413	21.0		40.32	0.54					43.2	38.8	8.5	2.2											
156	14-Feb-86	4500	0	4.9	35.0	6.91	5434	32.0		55.56	1.21	4030	2430	2305	1.05															1400
157	15-Feb-86	4000	0	6.3	35.0	6.81	5466	22.0		62.50	1.00																			
158	16-Feb-86	0	0		34.0	6.91	5488	15.0			0.00																			
159	17-Feb-86	4000	0	6.3	34.0	6.96	5503	22.0		62.50	1.00	3900	2499	2126	1.18	52.3	33.7	5.6	1.4											
160	18-Feb-86	1500	0		34.0		5525	17.0		166.67	0.40																			
161	19-Feb-86	2500	0	5.7	32.0		5542	19.0		100.00	0.67									15490	4470	4490	3090				16140	9250	7350	79.5	
	AVERAGE	2643	600	5.8	34.1	6.90		21.1	0.741	81.26	0.71	3965	2465	2216	1.12	47.8	36.3	7.1	1.8	15490	4470	4490	3090				16140	9250	7350	79.5	1600
162	20-Feb-86	0	0		33.0		5561	13.0			0.00					48.7	36.9	6.8	1.7											
163	21-Feb-86	2500	0	5.4	33.0	7.13	5574	16.0		100.00	0.67	3965	1957	2376	0.76															
164	22-Feb-86	3400	0	5.4	33.0	7.16	5590	20.0		73.53	0.92																			
165	23-Feb-86	0	0		34.0	7.15	5610	12.0			0.00																			
166	24-Feb-86	0	0	6.2	35.0	7.18	5622	2.0			0.00	4012	1615	2865	0.56	58.1	32.0	3.6	0.9											
167	25-Feb-86	4600	0	5.8	34.0	7.17	5624	20.0		54.35	1.24																			
168	26-Feb-86	5200	4200	6.0	34.0	7.05	5644	31.0		26.60	1.41									13730							15100	9450	7750	80.3	2160
	AVERAGE	2243	600	5.8	33.7	7.14		16.3	0.672	63.62	0.60	3989	1786	2721	0.66	53.4	34.5	5.2	1.3	13730							15100	9450	7750	80.3	2160
169	27-Feb-86	5600	0	6.1	34.0	6.95	5675	38.0		44.64	1.51					38.0	44.6	5.4	1.4											
170	28-Feb-86	3500	0	5.6	34.0	6.85	5705	36.0		71.43	0.94	3788	2493	2818	1.24															
171	01-Mar-86	3000	0	4.5	34.0	6.81	5741	27.0		83.33	0.81																			
172	02-Mar-86	0	0				5768	16.0			0.00																			
173	03-Mar-86	3600	0	6.2	35.0	6.95	5784	27.0		50.00	1.35	3826	2540	2823	1.26	53.6	34.1	5.1	1.4											
174	04-Mar-86	2500	0	6.1	34.5	6.83	5811	25.0		100.00	0.67																			
175	05-Mar-86	3600	0	6.0	34.0	6.90	5836	24.0		69.44	0.97									14640	4910	6210	2090				15610	9150	7450	81.4	
	AVERAGE	3314	0	5.8	34.3	6.90		26.4	0.739	69.81	0.89	3807	2517	2821	1.25	45.8	39.4	5.3	1.4	14640	4910	6210	2090				15610	9150	7450	81.4	

TABLE C-I MONITORING DATA FOR THE FULL-SCALE DIGESTER (CONT'D)

DAY	DATE	INFV	SUPL	INFV	TEMP	DIG	BIOGAS	SP.BIO PROD	SP.BIO PROD	HRT	LOAD RATE	ALK	VA	BA	VA/BA	BIOGAS QUALITY CH4	CO2	N2	O2	COD	FILTER COD	BOD	FILTER BOD	TKN	NH3	TP	TS	TSS	VSS	IVSS	SUPL COD
		IBPD	IBAL	pH	C	pH	m3	'000 ft3	m3/m3	d	kg/d	mg/L	mg/L	mg/L	mg/L	%	%	%	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L
176	06-Mar-86	4000	0	5.8	33.5	6.90	5860	23.0		62.50	1.00					44.3	38.8	6.8	1.8											
177	07-Mar-86	2500	0	6.0	34.0	6.80	5883	33.0		45.45	1.40	3695	2751	1870	1.47															
178	08-Mar-86	2000	0	6.7	33.0	6.70	5916	24.0		125.00	0.56																			
179	09-Mar-86	0	0		33.0	6.66	5940	17.0			0.00																			
180	10-Mar-86	3000	0	6.3	34.0	7.00	5957	13.0		83.33	0.81	3742	2690	1826	1.48	52.7	31.9	7.6	2.0											
181	11-Mar-86	0	8400		34.0	6.89	5970	17.0		29.76	0.81																			1920
182	12-Mar-86	2500	0	6.1	34.0	7.10	5987	27.0		45.45	1.40									15960						16300	10250	8150	77.3	
	AVERAGE	2057	1200	5.4	33.6	6.89		22.0	0.712	65.25	0.77	3719	2725	1848	1.48	48.5	35.4	7.2	1.9	15960						16300	10250	8150	77.3	1920
183	13-Mar-86	5000	0	6.3	34.0	6.95	6014	27.0		50.00	1.35					48.3	36.8	8.6	2.2											
184	14-Mar-86	4000	0	6.2	35.0	6.80	6041	25.0		62.50	1.00	3682	2701	1684	1.60															
185	15-Mar-86	4500	0	5.2	35.0	6.75	6066	24.0		55.56	1.21																			
186	16-Mar-86	0	0				6090	16.0			0.00																			
187	17-Mar-86	5250	0	6.3	34.0	6.95	6106	24.0		48.00	1.40	3491	2344	1827	1.28	56.2	34.3	6.3	1.0											
188	18-Mar-86	7500	0	6.5	34.0	7.11	6130	32.0		33.33	2.02																			
189	19-Mar-86	3000	8400	5.3	34.0	6.72	6162	28.0		21.93	0.82									13740	4960	6020	3980			12570	8050	6600	82.6	1810
	AVERAGE	4171	1200	5.3	34.3	6.88		25.1	0.350	45.23	1.12	3547	2523	1756	1.44	48.3	35.6	6.5	1.6	13740	4960	6020	3980			12570	8050	6600	82.6	1810
190	20-Mar-86	4000	0		34.0	6.62	6190	22.0		62.50	1.00					46.2	44.5	1.3	0.3											
191	21-Mar-86	5500	0	6.0	35.0	6.62	6212	30.0		45.45	1.40	3397	2620	1395	2.02															
192	22-Mar-86	3000	0	6.5			6242	19.0		83.33	0.81																			
193	23-Mar-86	0	0				6261	18.0			0.00																			
194	24-Mar-86	2000	0	6.0	35.0	6.72	6279	22.0		125.00	0.54	3397	2005	1466	2.00	59.1	36.5	2.5	0.6											
195	25-Mar-86	3500	0	6.2	34.0	6.86	6301	20.0		71.43	0.99																			
196	26-Mar-86	4000	0	6.0	35.0	6.63	6321	24.0		52.00	1.29									14073						14620	7650	6300	82.4	1810
	AVERAGE	3257	0	5.3	34.6	6.69		22.1	0.630	73.30	0.88	3397	2813	1401	2.01	52.7	40.5	1.9	0.5	14073						14620	7650	6300	82.4	1810
197	27-Mar-86	4000	4200	6.0	35.0	6.75	6345	25.0		50.49	1.00					52.6	41.3	0.9	0.2											
198	28-Mar-86	4000	0	6.1			6370	5.0		62.50	1.00																			
199	29-Mar-86	5000	0				6375	22.0		50.00	1.35																			
200	30-Mar-86	0	0				6397	17.0			0.00																			
201	31-Mar-86	3000	0				6414	8.0		83.33	0.81																			
202	01-Apr-86	4000	0				6432	16.0		62.50	1.00																			
203	02-Apr-86	4100	0				6448	17.0		60.98	1.10																			
	AVERAGE	3443	600	6.1	35.0	6.75		14.6		58.30	0.93					52.6	41.3	0.9	0.2											
204	03-Apr-86	3300	0		33.5	6.80	6465	17.0		75.76	0.89	3332	2094	1845	1.14					13800	4570	6020	3160							
205	04-Apr-86	6000	4200				6482	24.0		24.51	1.62																			
206	05-Apr-86	5300	0		35.0	6.70	6506	27.0		47.17	1.43																			
207	06-Apr-86	1200	0		35.0	6.60	6533	19.0		200.33	0.32																			
208	07-Apr-86	3500	0		34.5	6.65	6552	18.0		71.43	0.94																			
209	08-Apr-86	4000	0		34.5	6.60	6570	17.0		62.50	1.00																			
210	09-Apr-86	5500	4200		34.5	6.60	6587	23.0		25.77	1.48																			
	AVERAGE	4114	1200		34.5	6.66		20.7	0.467	73.64	1.11	3332	2094	1845	1.14					13800	4570	6020	3160							

TABLE C-1 MONITORING DATA FOR THE FULL-SCALE DIGESTER (CONT'D)

DAY	DATE	INFV 1000	SUPL 1000L	INFV pH	TEMP C	DIG pH	BIOGAS m3	PROD '000 ft3	SP.DIO PROD RATE m3/m3	HRT d	LOAD RATE kg/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA mg/L	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	FILTER COD mg/L	FILTER COD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	IVSS	SUPL COD mg/L
211	10-Apr-86	3600	0		34.5	6.71	6610	23.0			69.44	0.97																	
212	11-Apr-86	4000	0		35.0	6.70	6633	19.0			62.50	1.08	3183	2177	1637	1.33				15000	4220	5940	2410						
213	12-Apr-86	3000	0				6652	8.0			83.33	0.81																	
214	13-Apr-86	0	0				6660	9.0				0.00																	
215	14-Apr-86	3200	0		34.5	6.85	6669	21.0			78.13	0.86																	
216	15-Apr-86	4300	0		34.5	6.75	6690	17.0			58.14	1.16																	
217	16-Apr-86	3700	4200		34.0	6.70	6707	19.0			31.65	1.00																	
	AVERAGE	3114	600		34.5	6.74		16.6	0.493		63.86	0.84	3183	2177	1637	1.33				15000	4220	5940	2410						
218	17-Apr-86	4100	0		34.5	6.83	6726	18.0			60.98	1.10	3146	1870	1877	0.95				13700	3940	5940	2410						
219	18-Apr-86	8700	0		34.5		6744	20.0			28.74	2.34																	
220	19-Apr-86	0	0				6764	20.0				0.00																	
221	20-Apr-86	0	0				6784	13.0				0.00																	
222	21-Apr-86	4500	0		34.5	6.75	6797	22.0			55.56	1.21																	
223	22-Apr-86	4000	0		34.5	6.75	6819	17.0			62.50	1.08																	
224	23-Apr-86	3200	4200		34.5	6.74	6836	20.0			33.78	0.86																	
	AVERAGE	3500	600		34.5	6.77		18.6	0.492		48.31	0.94	3146	1870	1877	0.95				13700	3940	5940	2410						
225	24-Apr-86	5000	0		34.5	6.60	6856	21.0			50.00	1.35	2969	1615	1822	0.89				13200	3920	4040	2075						
226	25-Apr-86	6000	0		35.0	6.60	6877	25.0			41.67	1.62																	
227	26-Apr-86	2500	0				6902	19.0			100.00	0.67																	
228	27-Apr-86	0	0				6921	6.0				0.00																	
229	28-Apr-86	3000	0		34.5	6.83	6927				83.33	0.81																	
230	29-Apr-86	3000	0			6.80					65.79	1.02																	
231	30-Apr-86	4000	4200			6.70					27.78	1.29																	
	AVERAGE	3586	600		34.7	6.71		17.0	0.499		61.43	0.97	2969	1615	1822	0.89				13200	3920	4040	2075						
232	01-May-86	5000	0		35.0	6.85					50.00	1.35	3025	1837	1721	1.06				14350	3975	5210	2710						
233	02-May-86	6000	0		35.0	6.70					41.67	1.62																	
234	03-May-86	2500	0		35.0	6.70					100.00	0.67																	
235	04-May-86	0	0									0.00																	
236	05-May-86	2900	0		35.0	6.83					86.21	0.78																	
237	06-May-86	4200	0		35.0	6.60					59.52	1.13																	
238	07-May-86	3500	4200		35.0	6.60					25.77	1.40																	
	AVERAGE	3729	600		35.0	6.71					60.53	1.00	3025	1837	1721	1.06				14350	3975	5210	2710						
239	08-May-86	6000	0		35.0	6.65					41.67	1.62	2867	1858	1548	1.20				12967	3853	5620	940						
240	09-May-86	4500	0			6.50					38.46	1.75																	
241	10-May-86	0	0									0.00																	
242	11-May-86	0	0									0.00																	
243	12-May-86	3000	0		34.5	6.60					83.33	0.81																	
244	13-May-86	4000	0		35.0	6.70					62.50	1.08																	
245	14-May-86	4200	4200		35.0	6.70					29.76	1.13																	
	AVERAGE	3386	600		34.9	6.63					51.14	0.91	2867	1858	1548	1.20				12967	3853	5620	940						

TABLE C-I MONITORING DATA FOR THE FULL-SCALE DIGESTER (CONT'D)

DAY	DATE	INFV	SUPL	INFV	TEMP	DIG	BIOGAS	PROD	SP.BIO PROD	HRT	LOAD	ALK	VA	BA	VA/BA	BIOGAS QUALITY				FILTER	FILTER							SUPL
																CH4	CO2	N2	O2	COD	COD	BOD	BOD	TKN	NH3	TP	TS	TSS	VSS	IVSS	COD
		IGPD	IGAL	pH	C	pH	m3	'000 ft3	RATE m3/m3	d	kg/d	eq/L	eq/L	eq/L	eq/L	%	%	%	%	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L	eq/L		eq/L
246	15-May-86	2900	0		35.0	6.70				86.21	0.70	2941	1700	1720	0.99					12997	2430	3400	1510								
247	16-May-86	4000	0		35.0	6.70				62.50	1.00																				
248	17-May-86	2000	0		35.0	6.65				125.00	0.54																				
249	18-May-86	0	0								0.00																				
250	19-May-86	3000	0		34.5	6.80				83.33	0.81																				
251	20-May-86	4000	0		34.5	6.90				62.50	1.00																				
252	21-May-86	3000	4200		34.5	6.80				31.25	1.92																				
	AVERAGE	2814	600		34.8	6.74				75.13	0.76	2941	1700	1720	0.99					12997	2430	3400	1510								
253	22-May-86	2000	0		34.5	6.92				125.00	0.54	3183	870	2560	0.34					10099	1900	2850	1190								
254	23-May-86	400	0		35.0	6.80				625.00	0.11																				
255	24-May-86	0	0								0.00																				
256	25-May-86	0	0								0.00																				
257	26-May-86	2600	0		34.5	6.90				96.15	0.70																				
258	27-May-86	4100	0		35.0	6.90				60.98	1.10																				
259	28-May-86	3000	4200							34.72	0.81																				
	AVERAGE	1729	600		34.8	6.88				188.37	0.47	3183	870	2560	0.34					10099	1900	2850	1190								
260	29-May-86	6000	0		35.0	7.00				41.67	1.62	3239	292	3035	0.10					10349											
261	30-May-86	6700	0		35.0	7.00				37.31	1.80																				
262	31-May-86	2000	0							125.00	0.54																				
263	01-Jun-86	0	0			7.03					0.00																				
264	02-Jun-86	3400	0		34.5	7.00	6930	22.0		73.53	0.92																				
265	03-Jun-86	2300	0		35.0		6952	21.0		108.70	0.62																				
266	04-Jun-86	2800	4200				6973			35.71	0.75																				
	AVERAGE	3314	600		34.9	7.01		21.5	0.661	70.32	0.89	3239	292	3035	0.10					10349											
267	05-Jun-86	7000	0		35.0	6.95	6987	29.0		32.05	2.10	3314	440	3002	0.15					11075	1812	1950	430								
268	06-Jun-86	3000	0		35.0	6.50	7016	17.0		83.33	0.81																				
269	07-Jun-86	500	0				7033	9.0		500.00	0.13																				
270	08-Jun-86	0	0				7042	2.0			0.00																				
271	09-Jun-86	2500	0		34.5	7.00	7044	19.0		100.00	0.67																				
272	10-Jun-86	1200	0		34.5	7.00	7063	10.0		208.33	0.32																				
273	11-Jun-86	6000	4200		34.5	7.00	7073	25.0		24.51	1.62																				
	AVERAGE	3000	600		34.7	6.89		15.9	0.498	158.04	0.81	3314	440	3002	0.15					11075	1812	1950	430								
274	12-Jun-86	4500	0		34.5	7.00	7090	16.0		55.56	1.21	3314	277	3117	0.09					6614	560	1510	120								
275	13-Jun-86	5500	0		34.5	7.00	7114	24.0		45.45	1.48																				
276	14-Jun-86	700	0		34.5	6.90	7140	5.0		357.14	0.19																				
277	15-Jun-86	0	0				7145	1.0			0.00																				
278	16-Jun-86	3000	0		34.5	7.00	7146	16.0		83.33	0.81																				
279	17-Jun-86	1200	0		34.5	7.00	7162	11.0		208.33	0.32																				
280	18-Jun-86	4500	4200		34.5	7.00	7173	10.0	0.371	28.74	1.21																				
	AVERAGE	2771	600		34.5	6.98		13.3		129.76	0.75	3314	277	3117	0.09					6614	560	1510	120								

TABLE C-1 MONITORING DATA FOR THE FULL-SCALE DIGESTER (CONT'D)

DAY	DATE	WWEY TDPD	SUPL IBAL	WWEY pH	TEMP C	DIG pH	BIOGAS a3	PROD '000 ft3	SP.BIO PROD RATE a3/a3	HRT d	LOAD RATE kg/d	ALK eq/L	VA eq/L	BA eq/L	VA/BA eq/L	BIOGAS QUALITY CH4 %	CO2 %	H2 %	O2 %	COD eq/L	FILTER COD eq/L	FILTER BOD eq/L	BOD eq/L	TKN eq/L	NH3 eq/L	TP eq/L	TS eq/L	TSS eq/L	VSS eq/L	IVSS	SUPL COD eq/L
281	19-Jun-86	4500	0		34.5	7.00	7191	23.0		55.56	1.21	3267	425	2965	0.14					11034	1846	1620	770								
282	20-Jun-86	6700	0		33.0	7.00	7214	26.0		37.31	1.80																				
283	21-Jun-86	1500	0				7240	4.0		166.67	0.40																				
284	22-Jun-86	0	0				7244	1.0			0.00																				
285	23-Jun-86	6000	0		35.0	7.00	7245	28.0		41.67	1.62																				
286	24-Jun-86	5500	0		35.0	7.00	7273	23.0		45.45	1.48																				
287	25-Jun-86	4000	4200		35.0	7.00	7296	16.0		30.49	1.08																				
	AVERAGE	4029	600		34.9	7.00		17.3	0.390	62.86	1.00	3267	425	2965	0.14					11034	1846	1620	770								
288	26-Jun-86	3000	0		35.0	6.90	7312	40.0		43.10	1.56	3146	386	2872	0.13					8217	1415	981	385								
289	27-Jun-86	8500	0		33.0	6.90	7352	45.0		29.41	2.29																				
290	28-Jun-86	0	0		34.5	6.90	7397	7.0			0.00																				
291	29-Jun-86	0	0				7404	5.0			0.00																				
292	30-Jun-86	0	0				7409	4.0			0.00																				
293	01-Jul-86	0	0		35.0	6.80	7413	47.0			0.00																				
294	02-Jul-86	7500	4200		35.0	6.90	7460	40.0	0.494	21.37	2.02																				
	AVERAGE	3114	600					26.9		31.29	0.84	3146	386	2872	0.13					8217	1415	981	385								
295	03-Jul-86	5000	0		35.0	6.90	7500	27.0		50.00	1.35	2979	263	2792	0.09					7691	462	4100	51								
296	04-Jul-86	3500	0		35.0	6.90	7527	26.0		71.43	0.94																				
297	05-Jul-86	1000	0				7553	11.0		250.00	0.27																				
298	06-Jul-86	800	0				7564	7.0		312.50	0.22																				
299	07-Jul-86	8300	0		35.0	6.90	7571	45.0		30.12	2.23																				
300	08-Jul-86	0	0				7616	8.0			0.00																				
301	09-Jul-86	4500	4200		35.0	7.00	7624	31.0		28.74	1.21																				
	AVERAGE	3380	600		35.0	6.93		22.1	0.622	123.80	0.89	2979	263	2792	0.09					7691	462	4100	51								
302	10-Jul-86	6000	0		35.0	6.90	7655	42.0		41.67	1.62	3165	336	2927	0.12					7900	565	5710	190								
303	11-Jul-86	8000	0		34.5	6.90	7697	38.0		31.25	2.15																				
304	12-Jul-86	1000	0				7735	10.0		250.00	0.27																				
305	13-Jul-86	1000	0				7745	6.0		250.00	0.27																				
306	14-Jul-86	6000	0		34.5	6.90	7751	36.0		41.67	1.62																				
307	15-Jul-86	5000	0		34.5	6.90	7787	39.0		50.00	1.35																				
308	16-Jul-86	4000	4200				7826	31.0		30.49	1.08																				
	AVERAGE	4429	600		34.6	6.90		28.9	0.684	99.30	1.19	3165	336	2927	0.12					7900	565	5710	190								
309	17-Jul-86	5000	0		34.5	6.90	7857	33.0		50.00	1.35	2932	229	2769	0.08					7545	484	1900	160								
310	18-Jul-86	5000	0		35.0	6.90	7890	41.0		50.00	0.13																				
311	19-Jul-86	500	0				7931	10.0		500.00	0.05																				
312	20-Jul-86	200	0				7941	4.0		1250.00	1.35																				
313	21-Jul-86	5000	0		34.5	6.90	7945	34.0		50.00	1.35																				
314	22-Jul-86	5000	0		34.0	7.00	7979	34.0		50.00	1.35																				
315	23-Jul-86	5000	4200		35.0	7.00	8013	28.0		27.17	0.00																				
	AVERAGE	3671	600		34.6	6.94		26.3	0.824	282.45	0.00	2932	229	2769	0.08					7545	484	1900	160								

TABLE C-1 MONITORING DATA FOR THE FULL-SCALE DIGESTER (CONT'D)

								SP.BIO							BIOGAS QUALITY														
						BIOGAS	PROD	PROD		LOAD									FILTER		FILTER								SUPL
DAY	DATE	WWEY	SUPL	WWEY	TEMP	DIG	m3	'000	RATE	HRT	RATE	ALK	VA	BA	VA/BA	CH4	CO2	N2	O2	COD	COD	BOD	BOD	TKN	NH3	TP	TS	TBS	VBS	IVBS	COD
		IGPD	IGAL	pH	C	pH		ft3	m3/m3	d	kg/d	mg/L	mg/L	mg/L	mg/L	%	%	%	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L
316	24-Jul-86	4000	0		34.0	6.95	8041	35.0		62.50	1.00	3110	233	2953	0.08						7846	590	1460	190						
317	25-Jul-86	4000	0				8076	23.0		62.50	1.00																			
318	26-Jul-86	4000	0				8099	2.0		41.67	1.62																			
319	27-Jul-86	0	0		34.0	7.00	8101	5.0			0.00																			
320	28-Jul-86	4000	0		35.0	7.00	8106	33.0		62.50	1.00																			
321	29-Jul-86	4000	0		35.0	7.00	8139	36.0		62.50	1.00																			
322	30-Jul-86	3000	4200				8175	35.0		27.17	1.35																			
	AVERAGE	3857	600		34.5	6.99		24.1	0.380	53.14	1.04	3110	233	2953	0.08						7846	590	1460	190						
323	31-Jul-86	5000	0		35.0	7.00	8210	21.0		50.00	1.35	2951	245	2777	0.09						8360	473	1300	134						
324	01-Aug-86	5000	0		35.0	7.00	8231	26.0		50.00	1.35																			
325	02-Aug-86	0	0				8257	3.0			0.00																			
326	03-Aug-86	0	0				8260	6.0			0.00																			
327	04-Aug-86	4000	0		35.0	7.00	8266	42.0		41.67	1.62																			
328	05-Aug-86	3500	0		34.5	7.00	8308	45.0		45.45	1.48																			
329	06-Aug-86	3500	4200		34.5	6.98	8353	42.0		25.77	1.48																			
	AVERAGE	3857	600		34.8	6.98		26.4	0.635	42.58	1.04	2951	245	2777	0.09						8360	473	1300	134						
330	07-Aug-86	3500	0		34.5	6.98	8395	47.0		45.45	1.48	2932	290	2726	0.11						12000	500	1630	200						
331	08-Aug-86	3500	0		34.5	6.98	8442	38.0		45.45	1.48																			
332	09-Aug-86	0	0				8480	7.0			0.00																			
333	10-Aug-86	0	0				8487	8.0			0.00																			
334	11-Aug-86	4500	0		34.5	6.98	8495	49.0		38.46	1.75																			
335	12-Aug-86	4500	0		34.5	6.98	8544	48.0		38.46	1.75																			
336	13-Aug-86	3500	4200		34.5	7.00	8592	39.0		25.77	1.48																			
	AVERAGE	4214	600		34.5	6.92		33.7	0.742	38.72	1.13	2932	290	2726	0.11						12000	500	1630	200						
337	14-Aug-86	3500	0		35.0	7.00	8631	38.0		45.45	1.48	2839	268	2649	0.10						10755	732	2000	250						
338	15-Aug-86	3500	0		35.0	7.00	8669	33.0		45.45	1.48																			
339	16-Aug-86	0	0				8702	9.0			0.00																			
340	17-Aug-86	0	0				8711	14.0			0.00																			
341	18-Aug-86	3500	0		35.0	7.00	8725	36.0		45.45	1.48																			
342	19-Aug-86	3500	0		35.0	6.98	8761	26.0		45.45	1.48																			
343	20-Aug-86	3500	4200		35.0	6.98	8787	38.0		25.77	1.48	2806	316	2662	0.12						11120	934	1920	290						
	AVERAGE	3929	600		35.0	6.96		26.6	0.627	41.52	1.06	2863	292	2656	0.11						10938	833	1960	264						
344	21-Aug-86	3500	0		35.0	6.98	8817	40.0		45.45	1.48																			
345	22-Aug-86	3500	0		35.0	6.98	8857	25.0		45.45	1.48																			
346	23-Aug-86	0	0				8882	5.0			0.00																			
347	24-Aug-86	1000	0				8887	14.0		250.00	0.27																			
348	25-Aug-86	3500	0		34.5	7.00	8901	37.0		45.45	1.48																			
349	26-Aug-86	3500	0		34.5	7.00	8938	34.0		45.45	1.48																			
350	27-Aug-86	3500	4200		34.5	7.00	8972	36.0		25.77	1.48																			
	AVERAGE	4071	600		34.7	6.96		27.3	0.621	76.27	1.10																			

TABLE C-1 MONITORING DATA FOR THE FULL-SCALE DIGESTER (CONT'D)

DAY	DATE	WHEY IBPD	SUPL IBAL	WHEY pH	TEMP C	DIG pH	BIOGAS m3	PROD '000 ft3	SP.BIO PROD RATE m3/m3	HRT d	LOAD RATE kg/d	ALK mg/L	VA mg/L	BA mg/L	VA/BA mg/L	BIOGAS QUALITY CH4 %	CO2 %	N2 %	O2 %	COD mg/L	FILTER COD mg/L	FILTER BOD mg/L	TKN mg/L	NH3 mg/L	TP mg/L	TS mg/L	TSS mg/L	VSS mg/L	IVSS	SUPL COD mg/L
351	28-Aug-86	5000	0		34.5	7.00	9600	41.0		50.00	1.35	2867	245	2693	0.09	58.1	39.1	0.7	0.2	11292	742	1350	151							
352	29-Aug-86	5500	0		34.5	7.00	9849	34.8		45.45	1.48																			
353	30-Aug-86	5500	0		35.0	6.95	9883			45.45	1.48																			
	AVERAGE	5333	0		34.7	6.98		37.5	0.652	46.97	1.44	2867	245	2693	0.09	58.1	39.1	0.7	0.2	11292	742	1350	151							